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Environmental Assessment for the Sabine Pass Liquefaction Project

Cameron Parish, Louisiana

December 2011

Sabine Pass Liquefaction, LLC
and Sabine Pass LNG, L.P.
Docket No. CP11-72-000

Federal Energy Regulatory Commission
Office of Energy Projects
Washington, DC 20426

Cooperating Agencies:

U.S. Department of Transportation

U.S. Army Corps of Engineers

Department of Energy

DOE/EA-1845
DOE Docket No. FE 10-111-LNG
(DOE corrected cover: 7/31/2012)

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, D.C. 20426

OFFICE OF ENERGY PROJECTS

In Reply Refer To:
OEP/DG2E/Gas 2
Sabine Pass Liquefaction, LLC and
Sabine Pass LNG, L.P.
Sabine Pass Liquefaction Project
Docket No. CP11-72-000

TO THE PARTY ADDRESSED:

The staff of the Federal Energy Regulatory Commission (FERC or Commission) has prepared an environmental assessment (EA) for the Sabine Pass Liquefaction Project (Project), proposed by Sabine Pass Liquefaction, LLC and Sabine Pass LNG, L.P. (collectively referred to as Sabine Pass) in the above-referenced docket. Sabine Pass requests authorization to construct and operate facilities to be used for the liquefaction and exportation of natural gas at the existing Sabine Pass LNG Import Terminal in Cameron Parish, Louisiana. The Project would be capable of processing an average of approximately 2.6 billion cubic feet per day of pipeline quality natural gas from the Creole Trail Pipeline, which interconnects with the SPLNG Terminal. Sabine Pass would liquefy the natural gas, store the liquefied natural gas (LNG), and export approximately 16 million metric tons per annum of LNG via LNG carriers.

The EA assesses the potential environmental effects of the construction and operation of the Project in accordance with the requirements of the National Environmental Policy Act (NEPA). The FERC staff concludes that approval of the proposed project, with appropriate mitigating measures, would not constitute a major federal action significantly affecting the quality of the human environment.

The Department of Energy, U.S. Army Corps of Engineers, and U.S. Department of Transportation participated as cooperating agencies in the preparation of the EA. Cooperating agencies have jurisdiction by law or special expertise with respect to resources potentially affected by the proposal and participate in the NEPA analysis.

The proposed Project includes the following facilities:

- Four LNG liquefaction trains (each train contains gas treatment facilities, six gas turbine-driven refrigerant compressors, waste heat recovery systems, induced draft air coolers, fire and gas detection and safety systems, control systems, and associated infrastructure);

- Additional power generation (including up to two gas turbine-driven generators, transformers, and other electrical accessories to supplement existing onsite power generation);
- Other infrastructure and modifications (including storage tanks for propane and ethylene refrigerants and the amine make up, replacement of in-tank LNG pumps and piping modifications to increase flow capacity and facilitate loading of LNG carriers, impoundments for the liquefaction trains, flares, recycle boil-off gas compressors, potable water, service water, and demineralized water systems); and
- New and remodeled buildings.

The FERC staff mailed copies of the EA to federal, state, and local government representatives and agencies; elected officials; environmental and public interest groups; Native American tribes; potentially affected landowners and other interested individuals and groups; newspapers and libraries in the project area; and parties to this proceeding. In addition, the EA is available for public viewing on the FERC's website (www.ferc.gov) using the eLibrary link. A limited number of copies of the EA are available for distribution and public inspection at:

Federal Energy Regulatory Commission
Public Reference Room
888 First Street NE, Room 2A
Washington, DC 20426
(202) 502-8371

Any person wishing to comment on the EA may do so. Your comments should focus on the potential environmental effects, reasonable alternatives, and measures to avoid or lessen environmental impacts. The more specific your comments, the more useful they will be. To ensure that your comments are properly recorded and considered prior to a Commission decision on the proposal, it is important that the FERC receives your comments in Washington, DC on or before **January 27, ~~2011~~.** 2012

For your convenience, there are three methods you can use to submit your comments to the Commission. In all instances please reference the project docket number (CP11-72-000) with your submission. The Commission encourages electronic filing of comments and has expert staff available to assist you at (202) 502-8258 or efiling@ferc.gov.

(1) You can file your comments electronically using the eComment feature on the Commission's website (www.ferc.gov) under the link to Documents and Filings. This is an easy method for submitting brief, text-only comments on a project;

(2) You can file your comments electronically using the eFiling feature on the Commission's website (www.ferc.gov) under the link to Documents and Filings. With eFiling, you can provide comments in a variety of formats by attaching them as a file with your submission. New eFiling users must first create an account by clicking on "eRegister." You must select the type of filing you are making. If you are filing a comment on a particular project, please select "Comment on a Filing"; or

(3) You can file a paper copy of your comments by mailing them to the following address:

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street NE, Room 1A
Washington, DC 20426

Any person seeking to become a party to the proceeding must file a motion to intervene pursuant to Rule 214 of the Commission's Rules of Practice and Procedures (18 CFR 385.214).1 Only intervenors have the right to seek rehearing of the Commission's decision. The Commission grants affected landowners and others with environmental concerns intervenor status upon showing good cause by stating that they have a clear and direct interest in this proceeding which no other party can adequately represent. **Simply filing environmental comments will not give you intervenor status, but you do not need intervenor status to have your comments considered.**

Additional information about the project is available from the Commission's Office of External Affairs, at **(866) 208-FERC,** or on the FERC website (www.ferc.gov) using the eLibrary link. Click on the eLibrary link, click on "General Search," and enter the docket number excluding the last three digits in the Docket Number field (i.e., CP11-72). Be sure you have selected an appropriate date range. For assistance, please contact FERC Online Support at FercOnlineSupport@ferc.gov or toll free at (866) 208-3676, or for TTY, contact (202) 502-8659. The eLibrary link also provides access to the texts of formal documents issued by the Commission, such as orders, notices, and rulemakings.

[1] See the previous discussion on the methods for filing comments.

In addition, the Commission offers a free service called eSubscription which allows you to keep track of all formal issuances and submittals in specific dockets. This can reduce the amount of time you spend researching proceedings by automatically providing you with notification of these filings, document summaries, and direct links to the documents. Go to www.ferc.gov/esubscribenow.htm.

Kimberly D. Bose,
Secretary

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Acronyms and Abbreviations

°F	degrees Fahrenheit
ADT	average daily traffic
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
AOI	Area of Influence
Applicant	Sabine Pass Liquefaction, LLC, and Sabine Pass LNG, L.P.; *also* Sabine Pass
AQCR	Air Quality Control Regions
ASCE	American Society of Civil Engineers
BACT	Best Available Control Technology Analysis
Bcf/d	billion cubic feet per day
BGEPA	Bald and Golden Eagle Protection Act
BLEVE	boiling liquid expanding vapor explosion
BMP	best management practice
BOG	boil-off gas
BTU/ft^2-hr	British thermal units per squared feet per hour
BWE	ballast water exchange
BWM	National Ballast Water Management Program
BWT	ballast water treatment
CAA	Clean Air Act
CAMx	Comprehensive Air Quality Model with Extensions
CCS	Carbon Capture and Storage
CCTV	closed-circuit television
CEII	critical energy infrastructure information
CFR	Code of Federal Regulations
CH_4	methane
CI	Chief Inspector
CLIM20	Climatology of the United States No. 20 Monthly Station Climate Summaries
CO	carbon monoxide
CO_2	carbon dioxide
CO_2-eq	carbon dioxide equivalent
COE	(United States Army) Corps of Engineers

Commission, the	Federal Energy Regulatory Commission; *also* FERC
COTP	Captain of the Port
Creole Trail	Creole Trail Pipeline, L.P.
CWA	Clean Water Act
DA	Department of the Army
dBA	decibels on the A-weighted scale
DCS	distributed control system
DCS	distributed control system
DDT	deflagration-to-detonation transition
DMPA	dredge material placement area
DOE	(United States) Department of Energy
EA	Environmental Assessment
EFH	Essential Fish Habitat
EI	Environmental Inspector
EIS	Environmental Impact Statement
EO	Executive Order
ERP	Emergency Response Plan
ESA	Endangered Species Act
ESD	emergency shutdown
FE	(Office of) Fossil Energy
FEED	front end engineering design
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission; *also* the Commission
FGS	fire and gas systems
FR	*Federal Register*
FSP	Facility Security Plan
ft^3	cubic feet
FTA	Free Trade Agreement
GHG	greenhouse gas
GIWW	Gulf Intracoastal Waterway
GMFMC	Gulf of Mexico Fishery Management Council
gpm	gallons per minute
GWP	global warming potential

H_2S	hydrogen sulfide
HAP	hazardous air pollutant
HAZID	hazard identification
HAZOP	hazard and operability study
HDD	horizontal directional drill; *also* horizontal directional drilling
HDPE	high-density polyethylene
hp	horsepower
HVAC	heating, ventilation, and air conditioning
I-10	Interstate 10
IPCC	Intergovernmental Panel on Climate Change
K	Kelvin
kW	kilowatt
LA	Louisiana
LAAQS	Louisiana ambient air quality standards
LAC	Louisiana Administrative Code
LDEQ	Louisiana Department of Environmental Quality
L_{dn}	day-night averaged sound level
LDNR	Louisiana Department of Natural Resources
LDOTD	Louisiana Department of Transportation and Development
LDWF	Louisiana Department of Wildlife and Fisheries
LEL	lower explosive limit
L_{eq}	equivalent sound level
$L_{eq(24)}$	24-hour equivalent sound level
LFL	lower flammability limit
LNG	liquefied natural gas
LOI	Letter of Intent
LOS	Level of Service
LPG	liquid petroleum gas
$\mu g/m^3$	micrograms per cubic meter
m^3/hr	cubic meters per hour
MACT	Maximum Achievable Control Technology
MBTA	Migratory Bird Treaty Act
Mg/L	milligrams per liter
MMscf/d	million standard cubic feet per day

MOC	management of change
MOU	Memorandum of Understanding
mph	miles per hour
m/s	meters per second
MSL	mean sea level
mtpa	million metric tons per annum
MW	megawatt(s)
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAISA	National Aquatic Invasive Species Act of 2003
NANPCA	Non-indigenous Aquatic Nuisance Prevention and Control Act of 1990
NISA	National Invasive Species Act of 1996
NCDC	National Climatic Data Center
NEPA	National Environmental Policy Act (of 1969)
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFPA	National Fire Protection Association
NGA	Natural Gas Act
NNSR	Nonattainment New Source Review
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Oceanic and Atmospheric Administration National Marine Fisheries Service; *formerly* NMFS
NOI	Notice of Intent
NO_X	nitrogen oxide
NRCS	Natural Resources Conservation Service
NSA	noise sensitive area
NSPS	New Source Performance Standards
O&M	operations and maintenance
O_3	ozone
OEP	Office of Energy Projects
OSHA	Occupational Safety and Health Administration
P&ID	Piping & Instrument Diagram
PHMSA	Pipeline and Hazardous Materials Safety Administration

Plan	the Federal Energy Regulatory Commission's *Upland Erosion Control, Revegetation, and Maintenance Plan*
PM_{10}	particulate matter of 10 microns in diameter or less
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
ppb	parts per billion
ppb-v	parts per billion by volume
ppm	parts per million
ppm-v	parts per million by volume
ppt	part(s) per thousand
Procedures	the Federal Energy Regulatory Commission's *Wetland and Waterbody Construction and Mitigation Procedures*
Project, the	Sabine Pass Liquefaction Project; the subject of this Environmental Assessment
PSD	Prevention of Significant Deterioration
psi	pounds per square inch
psig	pounds per square inch gauge
PSM	Process Safety Management
PTE	potential to emit
RICE	reciprocating internal combustion engine
RMP	risk management plan
RO	reverse osmosis
RV	recreational vehicle
Sabine Pass	Sabine Pass Liquefaction, LLC and Sabine Pass LNG, L.P.; *also* the Applicant
SAC	standard annular combustor
SEP	surface emissive power
SH	State Highway
SHPO	State Historic Preservation Office
SIL	significant impact level
SIS	safety instrumented systems
SO_2	sulfur dioxide
SPCC Plan	Spill Prevention, Control, and Countermeasures Plan
SPLNG Terminal	Sabine Pass LNG Terminal
STEP	Shipboard Technology Evaluation Program
TAHS	turbine air humidification system

TAP	toxic air pollutant
TCEQ	Texas Commission on Environmental Quality
TDS	total dissolved solids
tpy	tons per year
Transco	Transcontinental Gas Pipe Line Company, LLC
tsf	tons per square foot
TSP	total suspended particulates
TX	Texas
UFU	upper flammability limit
URS	URS Corporation
USC	United States Code
UFL	upper flammability limit
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGCRP	United States Global Change Research Program
USGS	United States Geological Survey
VISCREEN	Visibility Screening
VOC	volatile organic compound
WSA	Waterway Suitability Assessment

1 Sabine Pass Liquefaction Project

1.1 Introduction

On January 31, 2011, Sabine Pass Liquefaction, LLC, and Sabine Pass LNG, L.P. (collectively referred to herein as Sabine Pass), filed an application in Docket No. CP11-72-000 with the Federal Energy Regulatory Commission (Commission or FERC) pursuant to Section 3(a) of the Natural Gas Act (NGA) and Part 153 of the Commission's regulations. Sabine Pass requests authorization to site, construct, and operate liquefaction and export facilities at the existing Sabine Pass LNG (SPLNG) Terminal in Cameron Parish, Louisiana (referred to herein as the Sabine Pass Liquefaction Project, or the Project). The Project would provide the capability to liquefy domestic natural gas supplies for export of approximately 16 million metric tons per annum (mtpa) of liquefied natural gas (LNG). Prior to filing its application, Sabine Pass participated in the Commission's pre-filing process for this Project under Docket No. PF10-24.

On November 21, 2008, Cheniere Marketing, LLC (a subsidiary of the parent company of Sabine Pass) filed an application with the United States Department of Energy's (DOE's) Office of Fossil Energy (FE) for blanket authorization to import and export natural gas from and to Canada and Mexico, to export LNG to Canada and Mexico, and to import LNG from various international sources up to a combined total of the equivalent of 1,500 Billion cubic feet per day (Bcf/d) of natural gas. Cheniere Marketing, LLC requested the authorization be granted for a two year term beginning on January 29, 2009. The FE's authority to regulate the imports and exports of natural gas, including LNG, is explained under Section 3 of the NGA and Section 301(b) of the DOE Organization Act, 42 United States Code (USC) 7151, and that authority was delegated to the Assistant Secretary for the Office of Fossil Energy in Redelegation Order No. 00-002.04D, issued November 6, 2007. The DOE granted this authorization on January 23, 2009.

On August 11, 2010, Sabine Pass filed an application with the DOE's FE requesting long-term, multi-contract authorization to export up to 16 million metric tons per annum, equivalent to 2.2 Bcf/d, of domestically produced LNG from the SPLNG Terminal to any nation that currently has or develops the capacity to import LNG and with which the United States currently has, or in the future enters into, a Free Trade Agreement (FTA) requiring the national treatment for trade in natural gas and LNG (FE Docket No.10-85-LNG). Sabine Pass requested this export authorization for a 30-year term commencing the date of first export, with such first export to occur no later than 10 years from the date of issuance of the authorization. DOE granted this authorization on September 7, 2010.

On September 7, 2010, Sabine Pass filed an application with the DOE's FE requesting long-term, multi-contract authorization to export up to 16 million metric tons per annum, equivalent to 2.2 Bcf/d, of domestically produced LNG from the SPLNG Terminal to any country with which the United States does not have a FTA requiring the national treatment for trade in natural gas, that has or in the future develops the capacity to import LNG, and with which trade is not prohibited by U.S. law or policy (FE Docket No.10-111-LNG). Sabine Pass requested this export authorization for a 20-year term commencing the earlier of the date of first export or five years from the date of issuance of the requested authorization. The DOE granted this authorization on May 20, 2011, under the condition of satisfactory completion of the environmental review process and that a finding of no significant impact or a record of decision pursuant to the National Environmental Policy Act of 1969 (NEPA) would be issued.

The Commission previously authorized Sabine Pass, in Docket Nos. CP04-47-000 and CP05-396-000, to site, construct, and operate the SPLNG Terminal as an LNG import, storage, and vaporization terminal with total send-out capacity of 4 Bcf/d. Phase I of the SPLNG Terminal, consisting of 2.6 Bcf/d of send-out capacity, was placed in commercial operation in 2008. Phase II, consisting of an additional 1.4 Bcf/d of capacity, was placed in commercial operation in 2009. The environmental review for the

Phase I and Phase II facilities was included in the Final Environmental Impact Statement (FEIS) issued in November 2004 and in the Environmental Assessment (EA) issued in May 2006, respectively. In addition, FERC authorized Sabine Pass, in Docket Nos. CP04-47-001 and CP05-396-001, to operate the SPLNG Terminal for the additional purpose of exporting foreign-sourced LNG. The environmental review for exporting foreign-sourced LNG was performed in the EA issued in February 2009.

FERC staff prepared this EA to address the potential environmental impacts of the Project in compliance with NEPA requirements and regulations issued by the Council on Environmental Quality at Title 40 of the Code of Federal Regulations (CFR) Parts 1500-1508, and the Commission's regulations at 18 CFR Part 380. The DOE, the United States Army Corps of Engineers (COE), and the United States Department of Transportation (USDOT) participated as cooperating agencies in the preparation of this EA.

1.2 Proposed Facilities

Sabine Pass proposed to add liquefaction capability to the existing SPLNG Terminal in Cameron Parish, Louisiana. Figure 1.2-1 illustrates the general location of the authorized existing SPLNG Terminal. All proposed facilities would be constructed and operated within the existing, leased 853-acre terminal site as shown on Figure 1.2-2.

The Project would be designed to process approximately 2.6 Bcf/d of pipeline-quality natural gas that would be delivered to the SPLNG Terminal through the interconnecting Cheniere Energy, Inc., Creole Trail Pipeline. Natural gas would be liquefied and stored in the SPLNG Terminal's five existing metal, double-walled, single containment storage tanks with secondary impoundment. LNG would be exported from the terminal via LNG carriers that would arrive at the SPLNG Terminal via marine transit through the Sabine Pass Channel. The liquefaction facilities would consist of four ConocoPhillips Optimized Cascade® LNG trains, each capable of processing up to 0.7 Bcf/d of natural gas, with average liquefaction capacity of approximately 3.5 to 4.0 million mtpa. Each liquefaction train would consist of facilities for pre-treatment and liquefaction as described in detail below. Sabine Pass anticipates constructing the proposed facilities in two stages.

Stage 1 would include the following facilities:

- Two liquefaction trains, including pre-treatment and liquefaction facilities described below (each train would include six LM2500+ G4 gas turbine-driven refrigerant compressors);
- Two propane, three ethylene, and one amine storage tanks;
- One wet flare, one dry flare, and one marine loading flare;
- Five boil-off gas (BOG) compressors;
- One demineralized water tank;
- Two natural gas-fired standby generators;
- Replacement of ten existing in-tank LNG pumps;
- Improvements to Lighthouse Road and plant roads; and
- New buildings.

02:003082.SP19.01\Graphics\Figure 1.2-1_General Location Map.cdr-10/12/11-GRA

SOURCE: Sabine Pass, 2011

Figure 1.2-1 General Location Map
Sabine Pass Liquefaction Project, Cameron Parish, Louisiana

SOURCE: Sabine Pass, 2011

Figure 1.2-2 Location of Liquefaction Facilities (Aerial View)
Sabine Pass Liquefaction Project, Cameron Parish, Louisiana

Stage 2 of the Project would include the following facilities:

- Two liquefaction trains, including pre-treatment and liquefaction facilities described below (each train would include six LM2500+ G4 gas turbine-driven refrigerant compressors);
- Two LM2500+ G4 gas turbine generators to supply additional electrical power;
- One wet flare and one dry flare; and
- Modifications and additions to existing utilities and infrastructure to accommodate the two additional trains.

Pre-treatment System

Natural gas would be delivered to the SPLNG Terminal via a new 42-inch diameter 400-foot-long receiving pipeline segment from the Creole Trail Pipeline. It would be metered and enter the gas pre-treatment section of the liquefaction facilities to remove components within the gas stream in preparation for liquefaction. The components to be removed include solids, carbon dioxide (CO_2), hydrogen sulfide (H_2S), water, and mercury.

An acid gas removal system using recirculating activated methyldiethanolamine (amine) would remove CO_2 and trace amounts of H_2S from the incoming feed gas. Proper removal of the CO_2 and H_2S is necessary to prevent potential freezing problems downstream in the liquefaction process and to meet LNG product quality specifications. Each liquefaction train would have a recirculating amine system consisting of an absorber, a regenerator, and associated equipment. Amine would be selected as the solvent for acid gas removal. One 41,600-gallon tank common to all four liquefaction trains would be provided to store make-up amine. The acid gas, comprised of CO_2 with traces of H_2S, would be removed through the acid gas vent stack (one per liquefaction train) or flared through the wet flare system.

Each liquefaction train would have a dehydration system that consists of three molecular sieve dehydration beds. The final traces of water vapor would be removed from the feed gas and retained within these beds. The dehydration beds would be regenerated by back-flowing clean, dry effluent gas heated by waste heat from gas turbine exhausts. The adsorbed water removed from the beds would be sent to the effluent treatment system. The regeneration gas would be re-circulated and combined with the feed gas to the acid gas removal unit.

The final gas pre-treatment step would utilize a mercury removal system to remove any trace amounts of mercury to protect downstream liquefaction equipment. Each liquefaction train would have a mercury removal system consisting of two mercury removal beds.

Liquefaction System

The dry gas would be fed to the refrigeration systems where it would be liquefied into the LNG product through a combination of heat exchangers and pressure reduction processes, which utilize propane, ethylene, and methane refrigerants. Each of the four liquefaction trains would include six LM2500+ G4 gas turbine-driven refrigerant compressors, each rated at 34.7 megawatts (MW), for a total of 24 refrigerant compressors. Two propane refrigerant compressors, two ethylene refrigerant compressors, and two methane compressors would be dedicated to each liquefaction train. Each liquefaction train would also include an ethylene cold box, a methane cold box, core and kettle heat exchangers, two LNG transfer pumps, approximately 160 induced draft air coolers, and associated piping, instrumentation, electrical, utility, and appurtenances. The LNG product would then be pumped to the LNG storage tanks.

The refrigerant storage system would consist of two 176,000-gallon storage tanks for propane refrigerant storage and three 71,000-gallon storage tanks for ethylene refrigerant storage.

Vapor Handling System

During normal operation, ambient heat input into the storage tanks and liquid-filled lines would cause a small amount of LNG to be vaporized. Some vaporization of LNG would also be caused by other factors, such as atmospheric pressure changes, heat input from pumping, and solar heat input from the piping system and tank walls. The vapor handling system would recover and compress these vapors (BOG) from the five existing LNG storage tanks and from the ship loading system, and return them to the liquefaction section of the facility to be re-liquefied. The vapor handling system would use five BOG recycle compressors rated each at 2,500 horsepower (hp). One compressor would be dedicated to each of the four liquefaction trains. The fifth compressor would be utilized during ship loading.

Safety and Controls System

Control and monitoring of the liquefaction facilities would be performed by a distributed control system (DCS) consisting of vendor-supplied package units with local control panels, numerous field-mounted instruments, and various operator interface stations located throughout the site. The DCS for the Project would interconnect with the existing SPLNG Terminal DCS for transferring critical data and interface for total plant monitoring and control.

An independent safety instrumented system would be installed to allow the safe, sequential shutdown and isolation of the liquefaction trains and common support facilities. Emergency shutdowns would be provided for the liquefaction facilities (integrated with the LNG Terminal facilities), each of the two ship unloading/loading systems, and for specific equipment.

Spill Containment System

A system of collection troughs to contain potential LNG and refrigerant spills and a new impoundment sump for the liquefaction facilities would be added. Sabine Pass proposes to provide curbing around the refrigerant storage system, which would be sloped to direct any spills to the collection troughs. Sabine Pass states that the sump would provide containment for a 10-minute spill from a single full-bore pipe rupture that would produce the highest release rate. The liquefaction impoundment sump would be 75 feet in diameter and 11 feet deep, with a total volumentric capacity of 48,596 cubic feet (ft^3).

Sabine Pass does not propose to modify the spill containment troughs to the ships from the storage tanks for this Project. The troughs are designed to hold the volume of LNG that could be released during a 10-minute spill from a single pipe rupture and would carry the same flow as authorized for the Phase I Project.

Hazard Detection System

The existing system provides alarm signaling and notification when a hazardous condition is present. The fire and gas detection system for the existing SPLNG Terminal would be expanded to protect the new liquefaction facilities and perform as a continuous monitoring system. The following are design and operating features of the hazard detection system that would be installed throughout the liquefaction facilities:

- Gas (point and open-path) and low temperature detectors would be provided in both the refrigerant storage, process, and containment areas in order to detect hydrocarbon and refrigerant vapors;
- Flame detectors to indicate ignition of vapors;
- Gas detectors in gas turbine enclosures and building air inlets to automatically shut down the equipment in the event of gas detection;
- Low temperature spill detectors in the impoundment basins would automatically stop the pumps in the affected basin; and

- Fire and combustible gas detectors with alarms that would require manual intervention.

Fire Protection System

The Project would tie into and expand the existing fire protection for the SPLNG Terminal.

Wheeled and hand-held dry chemical fire extinguishers would be strategically located throughout the liquefaction facilities. The turbine enclosure CO_2 extinguishing systems would automatically activate in the refrigerant compressor and electric generator turbine driver packages.

Firewater System

Sabine Pass states that the existing firewater system is adequately sized for the additional demands from the proposed liquefaction facilities. A new 24-inch high density polyethylene (HDPE) underground firewater ring main would be added and routed around the liquefaction trains. The new branch connections from the main firewater system would interface into the existing main firewater network and provide firewater coverage to the liquefaction trains, refrigerant storage area, utility facilities, and flare areas.

Emergency Shutdown System

The emergency shutdown system would consist of separate shutdown sequences, which would either be manually initiated by push buttons located in the field and control room or automatically initiated. The system would be designed to allow for areas of the liquefaction facilities to be shutdown, without necessarily shutting down the entire SPLNG Terminal. Four levels of shutdown would be configured for the liquefaction facilities to either shutdown individual liquefaction trains, shutdown all liquefaction trains, isolate feed gas into the liquefaction facilities, or isolate refrigerant storage facilities. Audible and visual alarms would be provided throughout the facility to alert personnel in affected locations (inside and outside).

Security System

The Project would expand the existing site security system of the SPLNG Terminal. Sabine Pass proposes to develop security procedures and systems for the proposed facilities and update the site's Emergency Response Plan (ERP), Facility Security Plan (FSP), and operating procedures. Sabine Pass plans to provide these updated plans and operating procedures to the appropriate agencies for review and would incorporate their comments into the ERP and FSP.

Security fencing would be provided around the new liquefaction facilities. The existing closed circuit television (CCTV) system would be expanded to allow operators and security staff to remotely view the new Liquefaction and Terminal plant areas from the control room and gate house. Security lighting would be powered by the standby generator in the event of a power supply failure and the Terminal perimeter would be protected with a perimeter intrusion detection system.

Utility Systems

The liquefaction facility would include the following safety control and utility systems:

- Fuel gas – Natural gas would be used to operate the liquefaction trains and to generate facility power. Sendout gas would be used as fuel gas for the gas turbine generators when LNG is being vaporized. BOG from the terminal would be used for the gas turbine generators to provide power to all idle facilities during times when the site is in standby mode.
- Electrical power – The existing four gas turbine generators would be capable of supplying power to the Stage 1 liquefaction facilities. Two additional gas turbine generators, each capable of generating approximately 30 MW of electricity, would be installed for the Stage 2

liquefaction facilities. The anticipated total operating load of the Stage 1 liquefaction facilities, including the existing SPLNG Terminal, would be approximately 76 million volt-amperes. The anticipated total operating load of the Stage 1 and 2 liquefaction facilities, including the existing SPLNG Terminal, would be approximately 110 million volt-amperes.

- Emergency generators – Two natural gas-fired emergency generators, rated at 1,500 kilowatts (kW) each, would provide back-up power: one feeding standby loads on liquefaction trains 1 and 2, including associated utilities (Stage 1); another feeding standby loads on liquefaction trains 3 and 4, including associated utilities (Stage 2).
- Instrument and plant air – Three electric motor-driven air compressor packages (two operating and one spare), rated for approximately 5.35 million standard cubic feet per day (MMscf/d), would provide dry air for operation of control instruments and service air for plant utility stations.
- Utility nitrogen – A membrane type nitrogen generator package would support maintenance purging of equipment and pipelines and operational blanket purges for certain equipment. Back-up liquid nitrogen would be provided by the existing liquid nitrogen system at the SPLNG Terminal.
- Hot oil – A hot oil system would be provided as the heating medium for the pre-treatment system. One hot oil surge drum would be provided for each liquefaction train.
- Vents and flares – One acid gas vent stack per liquefaction train, for a total of four, would safely vent acid gas from the solvent regenerator in each liquefaction train. The height of the vent stack would be 114.8 feet.

All liquefaction plant hydrocarbon relief loads would be routed to a closed flare system. The flares would be used as the control technology for volatile organic compounds (VOCs) and organic hazardous air pollutants. Sabine Pass proposes to achieve 98% combustion efficiency with the control technology overall conditions, including plant start-up, shut-down, continuous operation and emergency flaring at all rates. A total of five flares would be installed as described in Table 1.2-1.

Table 1.2-1
Proposed Flares for the Liquefaction Facility

Flare Type	Quantity	Stage 1 Flare Height (feet)	Stage 2 Flare Height (feet)
Marine Flare	1	132	-
Wet Flare	2	312	243
Dry Flare	2	312	243

Sabine Pass proposes to design the flares for no flow under normal conditions and to utilize the flares only under emergency relief conditions.

New Buildings

The Project would require several new buildings including:

- One warehouse to store spare parts and consumables;

- One waste and materials storage building for chemicals, lubricants, and other hazardous substances;
- One building for lockers, a canteen, offices, etc.; and
- Remote input/output buildings, an operator shelter, and substations, as needed.

Marine Terminal and LNG Transfer Lines

No additional marine facilities would be required for the Project. The check valve currently installed in the LNG unloading lines would be modified to simplify loading and unloading operations as the unloading rate would remain at the current rate of 12,000 cubic meters per hour (m^3/hr). Ten of the existing 15 in-tank pumps in the LNG storage tanks would be replaced with larger pumps (1,600 m^3/hr). The replacement of these pumps would allow Sabine Pass to run fewer pumps to achieve the 12,000 m^3/hr rate and would allow for redundancy and increased efficiency of the process. No modifications would be required for the LNG loading arms, berthing equipment, basin, or other portions of the marine terminal.

We received several comment letters with concerns regarding the increased number of ships associated with the Project, impacts on safety due to those additional ships, and the increased demands on the U.S. Coast Guard. The number of ships utilizing the SPLNG Terminal would not increase as a result of the Project. Sabine Pass is currently permitted for a maximum of 400 ships that could call on the terminal per year. Because loading rates proposed for the Project are the same as the unloading rates for the SPLNG Terminal, no increase in ship traffic is anticipated.

LNG Vaporization/Natural Gas Send-out

Except for the required tie-ins to the existing SPLNG Terminal facilities, no impacts or modifications would occur to the existing LNG vaporization facilities. Modifications to make the Creole Trail Pipeline flow bidirectional would be required. There are several potential scenarios for which compression may be added to the Creole Trail system. However, the precise nature and location of the required changes to accommodate the bi-directional flow of gas cannot be determined until Sabine Pass finalizes commercial arrangements with customers of the Project. Creole Trail would file with the Commission for any authorizations required to modify its pipeline system to accommodate the bi-directional flow of gas.

Also, Creole Trail would construct about 400 feet of new 42-inch diameter pipeline to supply feed gas to the Project. Creole Trail would construct this pipeline pursuant to its Blanket Certificate Authorization issued in Docket No. CP05-358-000.

Water Systems

Water for the service water, potable water, and demineralized water systems would be provided by the City of Port Arthur, Texas, local utility municipality, which is supplied by surface waters. Utility-supplied water would be further treated at the Project site to meet the specifications for each water system. Water from the local utilities would be split to supply water to the service water storage tank, potable water storage tank, and reverse osmosis (RO) storage tank. Service water would be provided to the utility wash stations.

Potable water would be treated using chlorination and ultraviolet disinfection packages. The potable water would be used for the turbine air humidification system (TAHS), safety showers, and eye-wash stations.

The Project includes two RO trains (one train would be a spare for cleaning and membrane replacement). After RO, the water is considered demineralized water. The demineralized water would be supplied to the gas turbine water injection system nitrogen oxide control, acid gas removal unit water wash, amine make-up, TAHS blend water, and gas turbine water wash.

1.3 Integral Components and Non-jurisdictional Facilities

1.3.1 Water Supply Line

In its application, Sabine Pass identified plans to construct a 12-inch diameter, 1.2-mile water supply pipeline from Sabine Pass, Texas, to the existing SPLNG Terminal site as shown in Figure 1.3-1. Sabine Pass would install this pipeline across the Sabine Pass Channel using the horizontal directional drill (HDD) method. The water supply pipeline was initially designed to supply approximately 2,200 gallons per minute (gpm) in order to provide additional quantities of water for Project operation in relation to:

- Feed source to the demineralized water system for injection into the gas turbines for nitrogen dioxide control, and for make-up of the amine unit;
- Humidification equipment at the inlet to the gas turbine drivers; and
- Potable water for the additional operation and maintenance personnel.

Upon further design of the Project, Sabine Pass filed updated water source needs, indicating that the Project would require approximately 875 gpm per train or 3,500 gpm of total potable water as the feed source for the demineralized water system. Based on this quantity, it appears that the current design of the pipeline capacity may not be sufficient to meet the Project's needs. Sabine Pass indicates that it is continuing to evaluate the water needs and supply for the Project. This EA evaluates the current location and method of installation of the waterline, along with the currently identified water needs for the Project.

The water supply line is also being evaluated as part of a COE Permit Application. Should it become necessary to modify the waterline specifications to supply additional water to the site, Sabine Pass would consult with the appropriate state and federal resource agencies to obtain or update its existing permits or authorizations, including: the COE (Section 10/404 Permit); Louisiana Department of Natural Resources (Coastal Use Permit); Louisiana Department of Wildlife and Fisheries (Habitat Evaluation); and Texas Railroad Commission (Waiver).

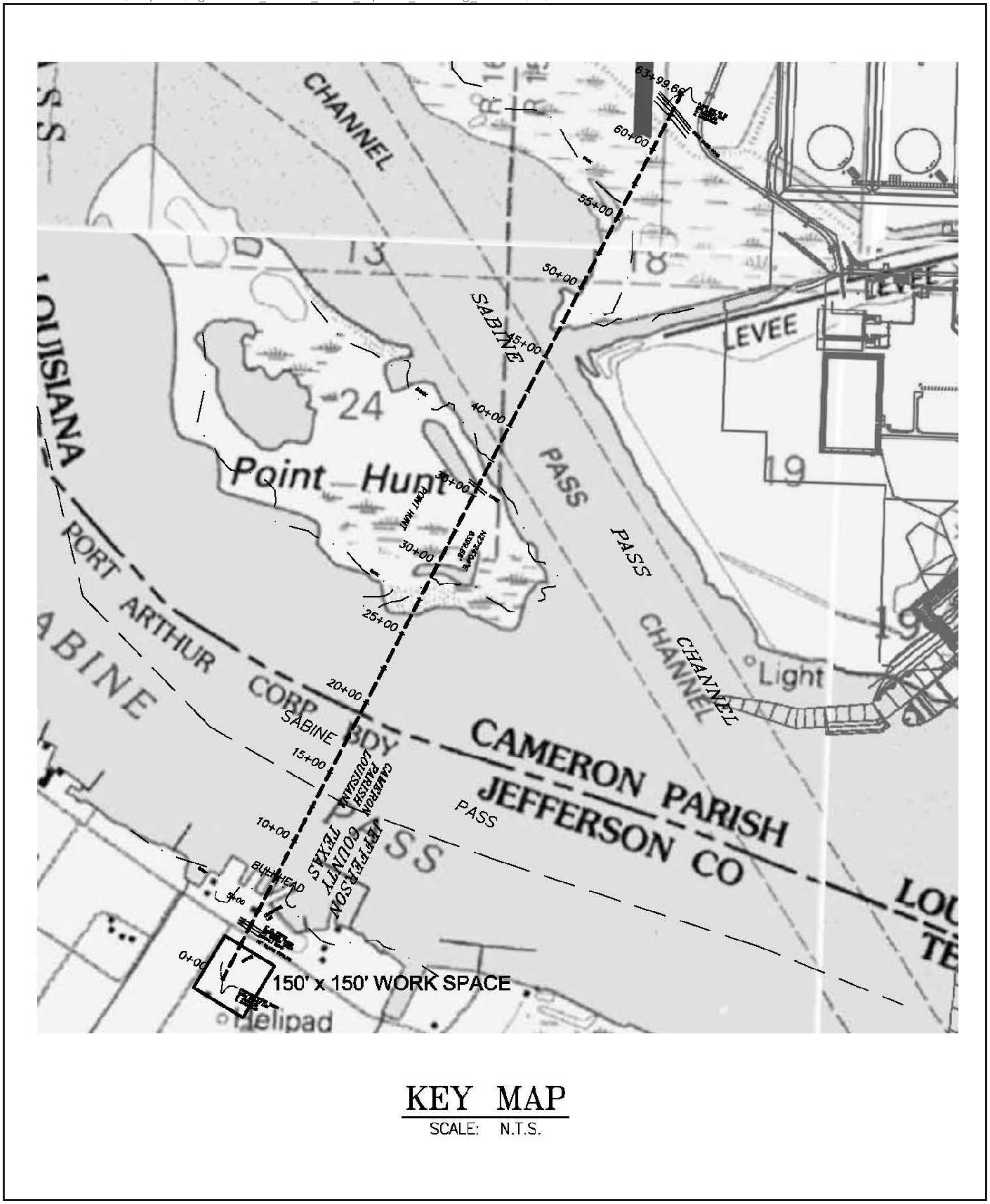
1.3.2 Non-Jurisdictional Facilities

No non-jurisdictional facilities are associated with the Project.

1.4 Purpose and Need

Sabine Pass states that the proposed liquefaction facilities described in Section 1.2 and subsequent exportation of domestic natural gas to the global market would provide a market solution to allow the further development of unconventional (particularly shale gas-bearing formation) sources in the United States. Sabine Pass indicates that the Project would result in the benefits listed below, each of which is in the public interest:

- Stimulation of the local, state, regional, and national economies through creation of jobs;
- Increased economic activity and tax revenues, and increased trade with neighboring countries;
- Improved domestic natural gas capacity and encouragement of solidarity in natural gas pricing;



SOURCE: Sabine Pass, 2011

Figure 1.3-1 Water Supply Pipeline Crossing Route
Sabine Pass Liquefaction Project, Cameron Parish, Louisiana

- Support of the National Export Initiative by exportation of approximately 2 Bcf/d of natural gas valued at approximately $5 billion and the displacement of $1.7 billion in LNG imports; and
- Simultaneous regasification of LNG and liquefaction of natural gas, eliminating the current practice of venting the gases elsewhere.

1.4.1 Department of Army Purpose and Need

The Project has a water-dependency purpose as it relates to the liquefaction and subsequent exportation of domestic natural gas. LNG ships would be utilized to transport LNG safely and efficiently worldwide. The Project would require a marine berth for loading and unloading of LNG vessels for waterborne transport of LNG. The marine facilities required for the export of LNG are already constructed and operational at the SPLNG Terminal. Locating the liquefaction facilities adjacent to the existing facility would provide the following benefits:

- Reduction of wetland and sensitive habitat impacts;
- Reduction of overall facility footprint;
- Access to the existing marine berth;
- Access to the existing infrastructure (LNG storage tanks and emergency equipment);
- Installation of fewer additional air emission sources; and
- Cost effectiveness.

Therefore, during the siting analysis of the Project, Sabine Pass concluded that because the export of LNG is water-dependent, the practicable alternatives are located within or adjacent to the existing facility.

1.4.2 Department of Energy Purpose and Need

The DOE's FE must meet its obligation under Section 3 of the NGA to authorize the import and export of natural gas, including LNG, unless it finds that the import or export is not consistent with the public interest. The purpose and need for DOE action is to respond to the September 7, 2010, application for authority to export LNG from the Project filed by Sabine Pass with the FE (FE Docket No.10-111-LNG).

The DOE is conducting its review under Section 3 of the NGA to evaluate the Project application for long-term, multi-contract authorization to export up to 16 mtpa of domestic natural gas as LNG for a 20-year period, commencing the earlier of the date of first export or five years from the date of issuance of the requested authorization. Sabine Pass seeks to export the LNG from the SPLNG Terminal to any country: (1) with which the United States does not have a free trade agreement requiring the national treatment for trade in natural gas and LNG; (2) that has, or in the future develops, the capacity to import LNG; and (3) with which trade is not prohibited by U.S. law or policy.

1.5 Scope of This Environmental Assessment

The topics addressed in this EA include alternatives; geology; soils; groundwater; surface waters; wetlands; vegetation; wildlife and aquatic resources; special status species; land use and visual resources; socioeconomics (including transportation and traffic); cultural resources; air quality and noise; reliability and safety; and cumulative impacts. The EA describes the affected environment as it currently exists, discusses the environmental consequences of the Project, and compares the Project's potential impact with that of various alternatives. The EA also presents our recommended mitigation measures.

When considering the environmental consequences of constructing and operating the Sabine Pass Liquefaction Project, the duration and significance of any potential impacts are described according to the following four levels:

- ***Temporary*** impacts generally occur during construction, with the resources returning to pre-construction conditions almost immediately;
- ***Short-term*** impacts could continue for approximately three years following construction;
- ***Long-term*** impacts would require more than three years to recover, but eventually would recover to pre-construction conditions; and
- ***Permanent*** impacts could occur as a result of activities that modify resources to the extent that they may not return to pre-construction conditions during the life of the Project, such as with the construction of an aboveground facility.

An impact would be considered significant if it would result in a substantial adverse change in the physical environment.

We received comments during the scoping period recommending that an Environmental Impact Statement (EIS), rather than an EA, be prepared to assess the impact of the Project. An EA is a concise public document which a federal agency may prepare to provide sufficient evidence and analysis for determining a finding of no significant impact. The Commission's regulations under 18 CFR 306(b) state that "If the Commission believe that a proposed action…may not be a major federal action significantly affecting the quality of the human environment, an EA, rather than an EIS, will be prepared first. Depending on the outcome of the EA, an EIS may or may not be prepared." In preparing this EA, we are fulfilling our obligation under NEPA to consider and disclose the environmental impacts of the Project. As noted above, this EA addresses the impacts that could occur on a wide range of resources should the Project be approved and constructed. Also, the DOE, COE, and USDOT have special expertise with respect to certain environmental impacts associated with Sabine Pass' proposal and assisted in preparing this EA. Based on our analysis, the extent and content of comments received during the scoping period, and considering that the Project would be located adjacent to the existing Sabine Pass LNG Terminal within the existing leased 853-acre leased terminal site, we conclude in Section 4 that the impacts associated with this Project can be sufficiently mitigated to support a finding of no significant impact and, thus, an EA is warranted.

1.5.1 U.S. Army Corps of Engineers Role

The Project would impact areas within the Galveston District of the COE. Wetlands in the Project area are regulated at the federal and state levels. The COE elected to cooperate in preparing this EA because it has jurisdictional authority pursuant to Section 404 of the Clean Water Act (CWA) (33 USC 1344), which governs the discharge of dredged or fill material into water of the United States, and Section 10 of the Rivers and Harbors Act (33 USC 403), which regulates any work or structures that potentially affect the navigable capacity of a waterbody.

The COE must comply with the requirements of NEPA before issuing permits under these statutes. In addition, when a Section 404 discharge is proposed and a standard permit is required, the COE must consider whether the proposed Section 404 discharge represents the least environmentally damaging, practicable alternative pursuant to the CWA Section 404(b)(1) guidelines. The COE must also carry out its public interest review process before a standard permit can be issued. Although this EA addresses environmental impacts associated with the Project as they relate the COE's jurisdictional permitting authority, it does not serve as a public notice for any COE permits or take the place of the COE's permit review process.

1.5.2 U.S. Department of Transportation Role

Under 49 USC 60101, the USDOT has prescribed the minimum federal safety standards for LNG facilities. Those standards are codified in 49 CFR Part 193 and apply to the siting, design, construction, operation, maintenance, and security of LNG facilities. The National Fire Protection Association (NFPA) Standard 59A, "Standard for the Production, Storage, and Handling of Liquefied Natural Gas," is incorporated into these requirements by reference, with regulatory preemption in the event of conflict. In accordance with the 1985 Memorandum of Understanding on LNG facilities and the 2004 Interagency Agreement on the safety and security review of waterfront import/export LNG facilities, the USDOT participates as a cooperating agency and assists in assessing any mitigation measures that may become conditions of approval for any project. USDOT staff has reviewed FERC staff's analysis and provided comments on our conclusions regarding compliance with the Part 193 regulations.

1.6 Public Involvement

On August 4, 2010, the Commission staff granted Sabine Pass's request to utilize the pre-filing process and assigned Docket No. PF10-24 to staff activities involved with the Project. The pre-filing process for the Project ended on January 31, 2011.

Sabine Pass hosted an open house information session for landowners, agencies, and other interested stakeholders on September 16, 2010, in Johnson Bayou, Louisiana. This open house provided stakeholders an opportunity to learn about the Project and ask questions in an informal setting. Notification of the open house was mailed to stakeholders and published in local newspapers. Sabine Pass also established a 24-hour landowner hotline and a Project Web site.

On October 29, 2010, we[2] issued a Notice of Intent (NOI) to prepare an Environmental Assessment for the Planned Sabine Pass Liquefaction Project and Request for Comments on Environmental Issues. This NOI was mailed to 80 interested parties, including federal, state, and local officials; agency representatives; conservation organizations; local libraries and newspapers; and property owners in the Project area. Throughout the review process, we received five environmental comment letters and interventions from citizens/interested parties, three letters from public interest groups, and letters from the National Marine Fisheries Service, U.S. Fish and Wildlife Service (USFWS), National Park Service, Louisiana State Governor's Office, and Louisiana Department of Wildlife and Fisheries (LDWF). Issues identified during the public comment process that are within the scope of the environmental analysis are addressed in the applicable sections of the EA.

During the pre-filing process, we conducted biweekly conference calls with Sabine Pass to discuss Project progress and identify and address issues and concerns that had been raised. Interested agencies were invited to participate on these calls. Summaries of our biweekly conference calls and written scoping comments are part of the public record for the Project and are available for viewing on the FERC Web site (http://www.ferc.gov).

1.7 Construction, Operation, and Maintenance Procedures

The Project facilities would be designed, constructed, operated, and maintained to conform to, or exceed, the requirements of the United States Department of Transportation "Minimum Federal Safety Standards," specified in 49 CFR 193.

[2] The pronouns "we," "us," and "our" used throughout this EA refer to the environmental staff of the FERC's Office of Energy Projects.

Sabine Pass has incorporated, in whole, the FERC's *Upland Erosion Control, Revegetation, and Maintenance Plan* (Plan) and *Wetland and Waterbody Construction and Mitigation Procedures* (Procedures) into its own construction and operating specifications for upland, wetland, and waterbody areas that would be affected by the Project. The only difference between Sabine Pass' Procedures and FERC's is with regard to Section VI.A.6 which requires all aboveground facilities to be located outside of wetlands, except where required for compliance with USDOT regulations. The Project would include aboveground facilities in wetlands that are within the previously disturbed dredge material placement area (DMPA). The impacts on these wetlands would be mitigated through consultation with federal and state agencies and addressed in a Project mitigation plan accompanying the CWA Section 404 permit application. Wetland impacts and alternative locations/configurations for the aboveground facilities are evaluated in this EA.

In order to operate its existing facility for the purpose of liquefying natural gas, Sabine Pass anticipates constructing the proposed facilities in two stages. Sabine Pass anticipates requesting authorization to commence construction of Stage 1 in January 2012, and Stage 2 would be constructed when commercially feasible, but no sooner than 2014. Sabine Pass expects Stage 1 to be operational by the second quarter of 2015 and Stage 2, if constructed, to be operational in early 2016.

1.7.1 Construction Procedures

For purposes of quality assurance and compliance with mitigation measures, other applicable regulatory requirements, and Project specifications, Sabine Pass would be represented on site by a chief inspector (CI), as well as one or more craft inspectors and one or more environmental inspectors (EIs).

The construction portion of the project would be in two stages. All land impacts associated with both stages would occur during Stage 1 construction because the Stage 2 Project areas would be used for Stage 1 workspace and access.

Site Preparation

The Project would involve modifications to the existing SPLNG Terminal facilities and the construction of new infrastructure. The site construction area would be approximately 288.21 acres, of which 136.28 acres are subject to Department of the Army (DA) permitting under Section 404 of the CWA and would include the installation of required construction power, communications, and water. Construction traffic would access the site via Louisiana State Highway (SH) 82. Once at the site, construction traffic would utilize Duck Blind Road, which parallels the western boundary of the SPLNG Terminal property, or Lighthouse Road, which is the SPLNG Terminal main entrance road that parallels the property's eastern boundary.

Site Grade and Fill

The process facilities for the Project would be west and northwest of the LNG storage tanks. Part of the Process Area is in relatively good soil that would require clearing, grubbing, and rough grading. The remaining portion of the Process Area would be located in an existing DMPA where soils would require considerable improvement and stabilization to provide a load-bearing surface for construction. The techniques to be used to improve the soils are similar to those used for construction of the existing SPLNG Terminal facilities. Various stabilizers that would be used include portland cement, fly ash, and other mixtures. Appropriate geogrids, geotextiles, and aggregates, where needed (imported gravel and crushed stone), would be used to level and finish the Project areas. Materials for site improvement, such as gravel and stone surfacing, would be imported via barge or trucks.

The LNG liquefaction area would be filled approximately 3 feet above existing ground surface. The total settlement as a result of placing fill of this thickness in the Project area is expected to be approximately 17 inches, and about 25% of the predicted total settlement would occur during fill placement. The balance of the settlement would occur at a decreasing rate over a period of about 30 to 50 years. Numerous settlement observation points would be identified prior to fill placement. The settlement of these points would be monitored at various times during and following fill placement to verify the predicted amount of settlement.

Materials and Equipment Delivery

Because major equipment would be delivered primarily by barge, improvements to the existing construction dock would be implemented. Maintenance dredging at the existing construction dock is anticipated to be necessary to restore the required depth of 17 feet. The maintenance dredge activities are authorized under Nationwide Permit 35 (SWG-2004-00465) issued on March 10, 2008, and renewed on July 21, 2010, and Coastal Use Permit P20071705, issued by the Louisiana Department of Natural Resources (LDNR). The Nationwide Permits should be modified, reissued, or revoked prior to March 18, 2012.

Construction Sequencing

The Project site would be graded and filled and all soil stabilization procedures executed prior to installation of infrastructure. All equipment and building materials would be delivered and staged on site. Installation of the trains and construction of the facility and associated infrastructure would commence.

1.7.2 Operation Procedures

The SPLNG Terminal would be a bi-directional facility, capable of loading and unloading LNG cargo, liquefying natural gas from the pipeline to produce LNG, and vaporizing stored LNG and sending the natural gas into the pipeline. We received comments regarding the operational capabilities of the SPLNG Terminal and how liquefaction operations may affection vaporization and import operations. Sabine Pass' customers would determine whether the facility is in liquefaction or vaporization mode. The terminal would also be capable of certain simultaneous operations normally associated with regasification or liquefaction including:

- Liquefying natural gas received from the Creole Trail Pipeline, while also vaporizing LNG and sending out natural gas;
- Unloading an LNG ship while liquefying natural gas; and
- Loading an LNG ship while vaporizing LNG.

Some simultaneous operations, such as unloading one LNG ship while simultaneously loading a different LNG ship on the other dock, are unlikely to occur for commercial reasons. Sabine Pass has not currently contemplated this in their design. LNG berthing operations would remain unchanged from current processes.

Additional operating procedures would be developed for the new liquefaction facilities, and training in accordance with the USDOT minimum federal safety standards specified in 49 CFR Parts 192 and 193 would be required for the 110 to 150 operational personnel.

1.7.3 Maintenance Procedures

Facility maintenance would be conducted in accordance with 49 CFR 193, Subpart G. Full-time terminal maintenance staff would conduct routine maintenance and minor overhauls. Major overhauls and other major maintenance would be handled by soliciting the services of trained contract personnel to perform the maintenance. All scheduled and unscheduled maintenance would be entered into a computerized maintenance management system. Scheduled maintenance would be performed on safety and environmental equipment, instrumentation, and any other equipment that would require maintenance on a routine basis.

1.8 Land Requirements

Approximately 288.21 acres of the existing 853-acre SPLNG Terminal site would be affected by construction of the Project, of which 191.20 acres would be permanently impacted during operations. Of these 191.20 acres, 136.28 acres are wetlands. The proposed facility would require relocation of a wetland compensatory mitigation site (Mitigation Site F), which was previously permitted under COE Permit 23426(04), totaling 72.24 acres for the SPLNG Terminal. Table 1.8-1 lists the land requirements for the Project.

Table 1.8-1
Land Requirements for the Proposed Sabine Pass Liquefaction Project

Facility	Land Impacted by Construction [(a)] (acres)	Land Impacted During Operation [(b)] (acres)
Liquefaction Project [(c)]	191.2	191.2
Staging Areas [(d)]	97.01	0.0
Total	288.21	191.2

Notes:
(a) Comprises the entire construction footprint, including all temporary and permanent construction areas.
(b) Includes the areas where soils would be improved and the permanent Project facility.
(c) Includes all areas of the site that would undergo soil improvement, including 12.84 acres for the sixth liquefied natural gas tank (Tank S-106), approved in Docket CP05-396-000 et al.
(d) Existing staging areas that were previously approved and have been converted to industrial land use as part of SPLNG Terminal operation.

1.9 Future Plans and Abandonment

Sabine Pass has not identified any specific future expansion. To the extent that expansion of the facilities is warranted in response to additional demand for liquefaction services, any new facilities would be designed to be compatible with the Project facilities, and Sabine Pass would obtain all necessary permits and approvals for those facilities.

No facilities are proposed for abandonment or removal at this time.

1.10 Required Consultation, Approvals, and Permits

As the lead federal agency for the Project, FERC is required to comply with Section 7 of the Endangered Species Act, the Magnuson-Stevens Fishery Conservation and Management Act, Section 106 of the National Historic Preservation Act, and Section 307 of the Coastal Zone Management Act. At the federal level, required permits and approval authority outside of FERC's jurisdiction include compliance with the CWA, the Rivers and Harbors Act, the Clean Air Act, and U.S. Coast Guard regulations relating to LNG waterfront facilities. The current status of these reviews, approvals, and consultations as well as those at the state, local, and tribal level are summarized in Table 1.10-1.

Table 1.10-1
Permits and Consultations for the Liquefaction Project

Agency	Permit/Consultation	Status
FEDERAL		
Federal Energy Regulatory Commission	Section 3 Application - Natural Gas Act	Application Filed January 31, 2011
U.S. Army Corps of Engineers	Section 10 – Rivers and Harbors Act (1899) and Section 404 - Clean Water Act Permit	Application Submitted January 31, 2011
U.S. Fish and Wildlife Service	Section 7 Consultation – Endangered Species Act Migratory Bird Treaty Act	Concurrence Letter Received October 5, 2010
U.S. Coast Guard	Letter of Intent and Waterway Suitability Assessment	Concurrence Letter Received June 24, 2010
U.S. Environmental Protection Agency Region VI	Clean Water Act Consultation	Application Submitted January 31, 2011
	Clean Air Act Consultation	Application Submitted December 17, 2010
NOAA Fisheries	Section 7 Consultation – Endangered Species Act	Concurrence Letter Received November 3, 2010
Federal Emergency Management, Region VI (FEMA)	Construction within a floodplain (Consultation – Copy of 404 Permit Application)	Application Submitted January 31, 2011
STATE		
Louisiana Department of Environmental Quality	Section 401 - Clean Water Act, Water Quality Certification	Application Submitted November 22, 2010
	Louisiana Pollutant Discharge Elimination System Construction Stormwater Permit	Application Submitted December 2010
	Air Permit	Permit Approved December 6, 2011
Louisiana Department of Natural Resources, Coastal Management Division	Coastal Management Plan Consistency Determination	Application Submitted November 22, 2010
Louisiana Department of Wildlife and Fisheries	Sensitive Species/Habitats Consultation	Concurrence Letter Received July 15, 2010
Louisiana State Historic Preservation Office	Section 106 - National Historic Preservation Act	Concurrence Letter Received July 2, 2010
LOCAL		
Cameron Parish	Building Permits	Application Submitted January 31, 2011
Cameron Parish Floodplain Administrator	Permit for Construction in a Zone "VE" or Variance as: functionally dependent use"	Application Submitted January 31, 2011

2 Environmental Analysis

2.1 Geology and Soil Resources

2.1.1 Geology, including Mineral and Gas Resources

Existing Environment

The Project would be located within the West Gulf Coastal Plain geomorphic province, which consists of Pleistocene and Holocene fluvial, tidal, and deltaic sediments that dip gently toward the Gulf of Mexico. The ground surface within the Project area is mostly comprised of Chenier plain and coastal plain sediments deposited by fluvial, tidal, littoral (beach or shoreline), and deltaic processes. The coastal plain is characterized as seaward-thickening sediment deposits to depths of thousands of feet below the present day land surface. The terrain is relatively flat to gently sloping. Two types of landforms characterize the Chenier plain: broad marshes containing organic clays and peat, and long, narrow relict beach features called “cheniers,” which appear as ridges parallel to the coast. Chenier ridges form as a result of cyclic shoreline advance and retreat, and are typically mixtures of silt, sand, and shell fragments. They are slightly elevated features and attain elevations of 5 to 10 feet above sea level.

The Project site is at the western edge of the Chenier plain and adjacent to the northwest corner of the existing SPLNG Terminal. The Chenier plain is found primarily in southwest Louisiana and consists of a 15- to 20-mile-long strip of Holocene deposits that extend from Vermillion Bay to Sabine Lake and the associated Sabine-Neches Waterway.

Mineral Resources

Mineral resources in the general Project vicinity include oil and gas, salt, sulfur, gravel, and clay. However, in the immediate area near the Project, exploitable minerals are limited to oil, gas, and sand.

The Project would lie within the West Johnsons Bayou Gas Field. Table 2.1-1 lists the mineral resources found on or adjacent to the Project. A review of the United States Geological Survey (USGS) Mineral Resource Data System indicates that no active or potential surface mines are located in the Project vicinity (USGS 1999).

Table 2.1-1
Mineral Resources On or Adjacent to the Project Site

Parish/State	Operation	Distance from Project Area	Operator
Cameron Parish, Louisiana	Gas, Condensate, and Oil Well	3,000 feet southeast of Liquefaction Trains	Noble Energy
	Gas and Oil Well	40 feet east of Lighthouse Road	Noble Energy

A producing gas, condensate, and oil well is located approximately 3,000 feet southeast of the proposed liquefaction trains. This well is the designated unit well for the Miocene Zone, Reservoir A, in the Siph Davis II sand and is perforated from 8,842 to 8,850 feet. The bottom coordinates of the well lie under Sabine Pass Channel. The current operator of the well is Noble Energy and the landowner, Crain Lands, L.L.C., maintains it. Additionally, a producing gas and condensate well is on the property located immediately east of the SPLNG Terminal (40 feet east of Lighthouse Road) and also is operated by Noble Energy.

Geologic and Other Natural Hazards

Seismicity and Faulting. Geologic features common to the Gulf Coast sedimentary environment are growth faults and faults associated with salt domes. Most faults in the Project area are considered to be active following their reactivation in the recent geologic past due primarily to oil and gas exploration and production. Observations made throughout the region during many years of oil and gas exploration indicate that movement along fault systems is related to a process of gradual creep, rather than sudden seismic events. As such, earthquakes with epicenters within southwest Louisiana or southeast Texas are rare and of low magnitude (Crone and Wheeler 2000). The Louisiana Gulf Coast, including the SPLNG Terminal site area, is located in Seismic Zone 0 of the Uniform Building Code's Seismic Risk Map (International Conference of Building Officials 1997). Peak ground accelerations adjusted for site effects for three probabilities of exceedance for the Liquefaction Project site are presented in Table 2.1-2.

Table 2.1-2
Seismic Hazard within the Project Area

	Probability of Exceedence in 50 years		
Peak Ground Acceleration Rate (percent gravity)	**10 Percent**	**5 Percent**	**2 Percent**
	3.33	6.30	12.85

Source: Compiled from USGS 2002 and adjusted for site effects per ASCE 7-05.

Hurricanes and Associated Coastal Processes. The Louisiana Gulf Coast experiences hurricanes and tropical weather systems that produce storm surges, high rainfall amounts and flooding, shoreline erosion, and high winds. According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps, the Project area is within Flood Hazard Zone VE, a 100-year flood hazard zone susceptible to coastal flooding. The Digital Storm Atlas of Texas predicts that a worst-case, Category 5 hurricane striking the Project site could produce a storm surge of up to 22 feet (Slatton et al. n.d.). Recent hurricanes that have come ashore near the terminal include Hurricanes Ike (2008) and Rita (2005). Hurricane Ike came ashore at Galveston Island as a strong Category 2 storm, with a storm surge of 15 to 20 feet. Hurricane Rita came ashore between Sabine Pass, Texas, and Johnson's Bayou, Louisiana, as a Category 3 storm, with a storm surge of 10 to 15 feet along the southwestern coast of Louisiana.

The Louisiana Gulf Coast is experiencing the highest rates of coastal erosion and wetland loss in the U.S. (Ruple 1993). The average coastal erosion rate is 4.2 meters per year in Louisiana and 1.8 meters per year along the northern Gulf of Mexico shoreline. However, the most serious erosion and land loss is occurring in the eastern part of the coastal area, east of Atchafalaya Bay. Sabine Pass does not appear to be subject to the same degree of overall land loss (USGS 2003).

Soil Liquefaction. Liquefaction is a phenomenon in which the strength and stiffness of a soil is reduced by earthquake shaking or other rapid loading. Liquefaction occurs in saturated soils; that is, soils in which the space between individual particles is completely filled with water. When liquefaction occurs, the strength of the soil decreases and the ability of a soil deposit to support foundations for buildings and other structures is reduced. Liquefaction occurs primarily in loose granular soils due to increase in pore pressures which reduces the effective confining pressure to a very low value resulting in continued deformation. Clays and clayey silts on the other hand are subject to "cyclic softening" during an earthquake thus resulting in bearing capacity or slope failures. The Project site has underlying sediment layers (primarily soft clay layers) that are saturated and subject to cyclic softening.

Subsidence. Subsidence hazards involve either the sudden collapse of the ground to form a depression or the slow subsidence or compaction of the sediments near the Earth's surface. As a result of sediment compaction, oil and gas extraction, and groundwater pumping, subsidence occurs throughout the Gulf Coast region. Subsidence in the coastal parishes of Louisiana averages 12 millimeters per year (Dokka, Shinkle, and Heltz 2003). In areas of high oil and gas production, subsidence occurs at a higher rate than in areas of low production. For example, Port Neches Field in Texas, northwest of the Project site, experienced subsidence rates 2.5 times greater than the average Louisiana coastal parish (Tolunay-Wong Engineers, Inc. 2003). Little groundwater pumping or oil and gas production occurs in the vicinity of the Project site, and the rate of subsidence in the vicinity of the Project site is low.

Solution mining of subsurface salt also may cause subsidence due to the collapse of overlying sediments; however, the nearest salt dome is located 12 miles from the Project site, so there is no risk of solution mining causing subsidence at the Project site. There is potential for compaction and differential settling of the soft sediments in the upper 70 to 80 feet of the Project site (Tolunay-Wong Engineers, Inc. 2003).

There is no karst terrain underlying the Project area; therefore, there is no potential for subsidence due to collapse of karst structures.

Tsunami. A 2009 USGS Study (Ten Brink et al.) presented a regional assessment of the tsunami potential in the Gulf of Mexico. The study concluded that there are no significant earthquake sources within the Gulf of Mexico that are likely to generate tsunamis that would affect the Project site. The URS Corporation's (URS's) Updated Site-Specific Hazard Analysis for the Project also indicates that there are no significant seismic sources in the Gulf. Earthquake sources outside the Gulf of Mexico are capable of generating tsunamis that can enter the Gulf; however, the wave amplitudes would be greatly attenuated due to the narrow and shallow passage of the Gulf. The maximum worst-case scenario tsunami run-up in the Gulf of Mexico from a distant source within the Gulf is estimated to be less than 1.0 meter. According to the authors, there is evidence that submarine landslides in the Gulf of Mexico should be considered as potential sources of tsunamis; however, no recorded tsunamis have been generated by a landslide in Gulf of Mexico. The probability of a tsunami run-up associated with landslides has not been quantified but is considered to be extremely low.

Impacts and Mitigation

Stage 1

Mineral Resources

The gas, condensate, and oil well located on the SPLNG Terminal site (3,000 feet away from the proposed liquefaction trains) would remain in production during construction and operation of the Project. The gas and condensate well located on the property adjacent to the SPLNG Terminal site would not be affected during construction or operation of the Project. Based on the known mineral resources that occur within the Project vicinity and the nature of the Project, no impacts to area mineral resources are anticipated.

Geologic and Other Natural Hazards

Seismicity and Faulting. Sabine Pass conducted a site-specific seismic hazard analysis of the SPLNG Terminal site as part of the environmental review for the Sabine Pass LNG Liquefaction Project. This study, which was performed by URS, determined that the probable ground motions and earthquake hazards at the site are low, even when site amplification effects are included, and are therefore generally not considered controlling factors in the facility design. However, all structures and facilities constructed for the Project would be designed to withstand a short-period design earthquake acceleration coefficient of S_{DS} = 0.12 and a one-second design earthquake acceleration coefficient of S_{D1} = 0.13 in accordance with American Society of Civil Engineers (ASCE) 7-05, “Minimum Design Loads for Buildings and Other Structures”; NFPA 59A; and 49 CFR 193.2067. Based on the site soils report, the site soil profile is classified as Site Class E in accordance with ASCE 7-05.

Hurricane and Storm Surge. The Project is designed for a 100-year storm surge of 14 feet for Port Arthur/southern Sabine Lake (COE 1968). This is roughly equivalent to the anticipated storm surge from a Category 3 hurricane making landfall at the SPLNG Terminal. Additionally, all critical components would be elevated to a minimum of 18.5 feet above mean sea level (MSL), thus minimizing potential impacts due to flooding associated with storm surge.

The facility would be designed in accordance with 49 CFR Part 193, which requires that the facility be designed to withstand sustained winds of 150 miles per hour (mph). All structures and facilities for the Project would be designed to withstand 150-mph winds (three-second gust wind speed) in accordance with ASCE 7-05, “Minimum Design Loads for buildings and Other Structures”; and NFPA 59A; and 49 CFR 193.2067.

Soil Liquefaction. Due to the presence of saturated sediments beneath the Project site, structures constructed at the site could be affected by cyclic softening and lateral spreading under sufficiently strong ground motion. However, because of the relatively low levels of seismic activity and probable ground motion predicted for the site, the risk of soil liquefaction and cyclic softening at the site is deemed minimal. Therefore, soil liquefaction is not considered a potential hazard to the Project.

Subsidence. Compaction of soft sediments near the surface could cause differential settling, particularly beneath the liquefaction area. Sabine Pass conducted an investigation of the soils and underlying sediments for the Project site to determine the most appropriate foundation type for the liquefaction area. The proposed liquefaction facilities would utilize the same deep-driven pile foundations as used with the adjacent SPLNG Terminal facilities, which are engineered to support the facilities in the event of long-term compaction of underlying soft sediments and minimize concerns associated with differential settling of soft sediments. Therefore, subsidence is not considered a potential hazard to the Project.

Tsunami. There are no significant seismic sources of tsunamis in the Gulf of Mexico; distant sources outside the Gulf of Mexico could produce tsunamis, but the maximum worst-case scenario run-ups would be less than 1 meter (3.28 feet) above MSL along the Gulf Coast. Because all critical components of the LNG project would be elevated to a minimum of 18.5 feet above MSL to protect against hurricane storm surge, no additional tsunami mitigation measures are deemed necessary.

Geotechnical Information

An investigation of the soil characteristics for the Project area was conducted in late 2010 by Tulunay-Wong Engineers for the Stage 1 (Trains 1 and 2) facilities area, and the resulting Geotechnical Recommendations Report was published in March 2011. The Project facility areas are located in more recent dredge material retention areas.

Based on the results of soil borings and cone penetrometer tests, the subsurface stratigraphy consists of three zones. The near-surface zone of soils consists of fat clays with scattered silty sand seams to a depth of about 59 to 76 feet below MSL. Some peat layers were encountered in this zone. Torvane tests and interpreted cone penetration test data indicated that the shear strength of the very soft to soft soil samples ranged from 0.05 tons per square foot (tsf) to 0.25 tsf. The moisture contents ranged from 31 to 118 percent, with most values ranging from 50 to 80 percent. Wet unit weights ranged from 87 to 107 pcf. Liquid limits ranged from 51 to 150. The plasticity indices ranged from 26 to 98. The natural moisture contents were generally about midway between the plastic limit and the liquid limit. The minus 200 sieve tests indicated that about 30 to 99 percent of the soil passed the No. 200 sieve. The lower values were within the silty sand layers.

The second zone consists of medium dense to very dense, cohesionless, silty sand and sands. The top of the sand layer ranges in depth from 62 to 75 feet below MSL. The thickness of the dense to very dense sand layer in the Liquefaction Project areas is variable across the site.

The third zone is present below the variable dense sand layer to the maximum exploration depth of up to 300 feet and is composed of a mixture of clays and sands. The clays are slightly over consolidated, and the sands are medium dense to very dense.

There are shallow (less than 6 feet) perched groundwater conditions in the more recent dredge material retention areas. The long-term ground level in the lower elevations of the site are expected to be the about the same level as the water in the adjacent navigational channel.

The Project would be developed similarly to the existing development in the SPLNG Terminal Phase 1 and 2 project areas. These higher-elevation dredge material retention areas would be stabilized in place to depths ranging from 3 to 8 feet, depending on the type of equipment that would be supported in those areas.

In the lower-elevation areas of the Project improvements, such as the process area, the site grading would include light stripping of grasses, placement of a geotexile or geogrid, and placement of fill to provide the appropriate elevations. In haul road or other areas, the roadways would be constructed using geogrids and selected granular fill.

The Project foundations would be similar to the existing SPLNG Terminal Phase 1 and 2 project foundations. Heavier equipment and structure foundations would be supported by up to 90-foot-long precast, pre-stressed concrete piles that would be driven a few feet into the dense sand layer (top of sand is 62 to 75 feet below MSL). Lighter equipment and structure foundations would be supported by 60-foot-long timber piles that would be driven to a depth of 45 feet below MSL. A few very lightly loaded mat foundations may be supported only by stabilized soil.

Stage 2

The Stage 2 construction and operation area would lie within the previously impacted Stage 1 construction workspaces. Therefore, the construction and operation of Stage 2 would have no additional effects on nearby mineral resources and would not be further impacted by the area's geologic hazards.

Geotechnical Information

An investigation of the soil characteristics for the Project area was conducted in early 2011 by Tulunay-Wong Engineers for the Stage 2 (Trains 3 and 4) facilities area, and their resulting Geotechnical Recommendations Report was published in June 2011. The investigation revealed that subsurface soil conditions were virtually identical to those for Stage 1. Therefore, the soil and site preparations and the foundations would be the same as those described above for the Stage 1 facilities.

Water Supply Pipeline

The water supply pipeline construction area would lie within and near the previously impacted workspaces of Stage 1 and Stage 2. The pipeline would extend from an existing water supply on the Texas side of the Sabine Pass Channel to the liquefaction trains at the terminal site. However, unlike aboveground facilities, the water supply pipeline would not be on piles. Subsidence as a result of sediment compaction is a concern in this part of the country; therefore, the water supply pipeline would be designed to withstand any subsidence that may occur in the area. The pipeline would be installed using HDD techniques. Therefore, construction of the water supply pipeline would have no additional effects on nearby mineral resources and would not be further affected by the area's geologic hazards.

Geotechnical Information

The maximum depth of the water supply pipeline constructed using HDD techniques would be 70 feet below MSL and a minimum of 20 feet below the bottom of the Sabine Pass Channel. No new specific geotechnical investigation was performed for the pipeline route. However, Boring B-12 performed for the Heavy Haul Road (Tolunay-Wong Engineers, Inc., 2011) is located close to the northern end of the pipeline, and Borings B-1, B-2, and B-3 performed for the water storage standpipe (Lind and Associates, Inc. 2004) are located at the southern end of the pipeline. Boring B-12 was drilled to a depth of 102 feet and Borings B-1, B-2, and B-3 were drilled to depths of 110 feet below the site grade. The subsurface soil conditions encountered by Boring B-12 consist of crushed limestone, clays, silts, and sands. Densities vary from soft to medium dense down to about 70 feet below ground surface, where the material transitions to very dense sand. The conditions encountered at the southern end of the pipeline are generally similar to those encountered at the northern end. Geotechnical information provided from these borings indicates that the HDD would encounter soft sediments during drilling. However, because of the potential for an inadvertent release of drilling mud during the drilling, an HDD Drilling Mud/Frac-Out Contingency Plan was prepared and was found acceptable.

Hazards associated with seismicity, faulting, soil liquefaction, subsidence, and tsunamis are minimal as described above for the Stage 1 facilities. The pipeline site is an area that is susceptible to hurricanes and storm surges. As the water supply pipeline would be installed underground, there would be minimal risk to the pipeline from coastal processes, storm surges, and hurricane winds.

2.1.2 Soils

Project Soil Series

Stage 1 and Stage 2 construction of the Project would affect a total of 288.21 acres of land within the existing SPLNG Terminal in Cameron Parish, Louisiana. Facility operations would affect a total of 191.20 acres.

The Project facilities would be underlain by three soil series. These include Udifluvents, 1 to 20 percent slopes; Aquents, frequently flooded; and Creole. These soils consist of Sabine Pass dredge spoil and predominantly lie within the DMPA. Additionally, the water supply pipeline HDD entry point is underlain by the Sabine-Baines complex. Table 2.1-3 and Figure 2.1-1 identify the soil series that would be permanently or temporarily affected by the Project.

Table 2.1-3
Project Site Soils Impacts and Characteristics

Soil Series	Project Component	Farmland Potential	Hydric Characteristics	Comments
Udifluvents, 1 to 20 percent slopes	Liquefaction Area, LNG Storage Tanks	Not Prime Farmland	Hydric	Dredge material, recent and historic (>30 years ago)
Aquents, frequently flooded	Access Roads, Temporary Workspaces	Not Prime Farmland	Hydric	Dredge material, historic (>30 years ago)
Creole, mucky clay	Access Roads	Not Prime Farmland	Hydric	Present along State Highway 82
Sabine-Baines complex	Water Supply Pipeline Entry Point	Not Prime Farmland	Hydric	Located at HDD entry point

Source: Midkiff, Roy, and Nolde 1995; NRCS 1995.
Key:
HDD = horizontal directional drilling
LNG = liquefied natural gas

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SOURCE: Sabine Pass, 2011

Figure 2.1-1 Project Site Soil Resources
Sabine Pass Liquefaction Project, Cameron Parish, Louisiana

Udifluvent soils consist of hydraulically dredged sandy, loamy, and clayey materials. Drainage varies but is typically slow in areas with shallow slopes. The Natural Resources Conservation Service (NRCS) classifies these soils as hydric. Udifluvent soils are considered unsuitable for crops, pasture, or woodland, and the NRCS does not consider them prime farmland. These soils are best suited for open land and wetland habitat (Midkiff, Roy, and Nolde 1995).

At the Project site, these soils consist of fine-grained clays with low chroma colors. The soils are typically saturated within the upper 12 inches. Mineral soils with no organic material development are present. The liquefaction facilities would be situated on Udifluvent soils.

Aquent soils typically are dredged soils consisting of gray silty clay loam, silty clay, and clay. These soils are commonly associated with the Udifluvents but are typically found at lower elevations. Frequent flooding, poor drainage, and moderate salinity make these soils unsuitable for urban uses, grazing, or cultivation. The NRCS classifies these soils as hydric. Aquent soils are considered unsuitable for crops, pasture, or woodland, and the NRCS does not consider them prime farmland (Midkiff, Roy, and Nolde 1995). These soils are best suited for wetland wildlife habitat.

At the Project site, these soils consist predominantly of clays with small pockets of sandy or silty material. Aquent soils occur primarily in low-lying areas at the Project site and are often saturated at the surface. These are also mineral soils with no organic layers developed. Areas of Aquent soils within the Project workspaces were previously permitted and disturbed during construction at the SPLNG Terminal and, therefore, would not be further affected by the Project.

Creole series soils consist of dark gray, very fluid, saline, mucky clay at the surface and very dark gray, slightly fluid, mucky clay underlain by mottled clay, very fluid loamy sand, clay loam, and clay. These soils are frequently inundated during the highest tides and are often ponded for long periods of time. Creole soils are unsuitable for cropland, pasture, woodland, or urban uses, and are not considered prime farmland. These soils are considered hydric and support native estuarine wetland vegetation (Midkiff, Roy, and Nolde 1995; NRCS 1995). They are primarily suitable for wetland wildlife habitat and occasionally suitable for rangeland wildlife habitat (Midkiff, Roy, and Nolde 1995). Areas of Creole soils within the Project workspaces were previously permitted and disturbed during construction at the SPLNG Terminal and, therefore, would not be further affected by the Project.

The Sabine-Baines complex is typically found in coastal marsh landscapes. Sabine soils are moderately acidic, very dark gray loamy fine sand at the surface and very dark grayish brown loamy fine sand with brown mottles and underlain by less acidic, light yellowish to gray loamy fine sand with brown and red mottles. Sabine soils are moderately well drained. Baines soils are slightly acid, slightly saline, black clay at the surface and underlain by moderately to slightly alkaline, slightly saline, gray or brown clay loam with brown mottles. The Sabine-Baines complex is mainly used as range and urban land and is not suitable for cropland. However, it provides a high yield of marsh grass and may also provide for good pastureland (USDA 2006).

Impacts and Mitigation

Stages 1 and 2

Construction and Operation Impacts

The total Project area footprint, including Stages 1 and 2, is comprised of unconsolidated soils derived from dredge spoil placement. These soils have no load-bearing capacity and cannot support heavy equipment or materials. To minimize the footprint of the project, Sabine Pass would utilize the areas identified for Stage 2 as construction workspace and equipment laydown for construction of the Stage 1 facilities. Therefore, it is necessary to stabilize the Stage 1 and Stage 2 areas at the same time in order to use these areas both as construction workspace and for installation of the facility infrastructure. Sabine Pass would increase the soil stability by mixing lime and/or fly ash with the existing soils to a depth of 2 to 7 feet below ground level, depending on the equipment to be placed on the location. In the liquefaction areas, these areas would be stabilized in place to depths required by the geotechnical evaluation. The stabilization would be accomplished by mixing and injecting the existing dredged soils with agents such as fly ash, lime, portland cement, cement kiln dust, and other proprietary materials. The soils would be improved to achieve compressive strengths of 20 to 25 pounds per square inch, which would increase soil volume.

The stabilization process would, however, convert hydric soils to upland soils, and these hydric areas would no longer be capable of supporting wetland vegetation. Sabine Pass would mitigate for wetland losses as specified under a Wetland Mitigation Plan to be approved by the COE after review of Sabine Pass's COE permit application for Project facilities. Wetlands adjacent to construction activities would be protected in accordance with Sabine's Plan and Procedures. We conclude that Sabine Pass's implementation of these measures, as well as the use of best management practices (BMPs) during construction, will minimize or mitigate for impacts on hydric soils.

Soils in this region typically have four limiting factors that could cause construction and operation issues. The limiting factors include severe erosion hazard, compaction potential, rock, and poor revegetation potential. The three soils that underlie the Project are identified in Table 2.1-4, along with their limiting factors.

Table 2.1-4
Soil Series and Major Soil Limitations for the Project

Soil Series	Severe Erosion Hazard	Compaction Potential	Rock	Poor Revegetation Potential
Udifluvents, 1 to 20 percent slopes	No	High	None	No
Aquents, frequently flooded	No	High	None	No
Creole mucky clay	No	High	None	No
Sabine-Baines Complex	No	High	None	No

Source: Midkiff, Roy, and Nolde 1995.

No soils present at the Project site have a severe erosion potential, the presence of bedrock, or poor revegetation potential. Therefore, these factors would not impact the Project construction or operation. However, a high compaction potential does exist with Project-related soils. These soils are predominantly clays or silty clays, are poorly drained, and have high shrink-swell potential, and thus are at risk for compaction. The potential impacts associated with compaction at the Project site would be minimal given that the site has been designed to incorporate systems to manage stormwater runoff that could be increased by compacted soils resulting from construction.

Mitigation

Project construction would disturb soils, resulting in a temporarily increased potential for erosion due to loss of soil structure. To limit the effects of erosion, Sabine Pass would use measures in its Plan. Appropriate erosion and sedimentation control measures, such as silt fencing, would be implemented and maintained at all times during construction of the Project site until revegetation has occurred. Following restoration and clean up, the disturbed areas would be monitored to maintain erosion control structures and to repair any erosion that occurs.

Water Supply Pipeline

The water supply pipeline entry point is not located in the Stage 1 or Stage 2 workspaces. However, the Sabine-Baines soil complex has characteristics similar to soils found at Stage 1 and Stage 2. Temporary matting would be used in these areas if the soil conditions are not sufficiently stable to support the necessary HDD equipment. Following construction, the temporary matting would be removed and the soils would be restored to pre-construction conditions. Similar to site construction, Sabine Pass would use its Plan for the water supply pipeline. Appropriate erosion and sedimentation control measures, such as silt fencing, would be implemented and maintained at all times during construction of the Project site until revegetation has occurred.

2.2 Water Resources

2.2.1 Surface Water Resources

Existing Environment

The Project site is within the Sabine Lake Watershed (Hydrologic Unit Code 1040201). This watershed covers an area of 1,040 square miles in Texas and Louisiana and is part of the larger Galveston Bay-Sabine Lake Watershed. From the north, two major rivers, the Sabine and Neches, discharge into Sabine Lake. South of Sabine Lake is the Sabine Pass Channel. This channel provides a narrow tidal inlet and is the outlet for this bay-estuary system to the Gulf of Mexico. The bay-estuary has a small diurnal tidal range of 1.6 feet. More significant in this area are wind-generated tides, which affect most bay and estuary environments and produce wind-tidal flats and marshes. Sources of fresh water into the bay-estuary system include streams and runoff; municipal, industrial, and agricultural return flow; and direct precipitation. The Sabine and Neches River Basins represent about 85 percent of the total freshwater inflows to the Sabine-Neches Estuary.

Tides interacting with freshwater river discharges into the system produce salinity gradients in estuarine and wetland areas, as well as strong salinity stratification within the ship channel. According to Fisher et al. (1973), salinities generally range from less than 10 parts per thousand (ppt) in the upper part of the lake and between 10 and 20 ppt in the tidally influenced lower part. The dynamic hydrologic nature of the estuary results in continuous changes to ambient physio-chemical water parameters.

The Louisiana Department of Environmental Quality (LDEQ) designated water uses for Sabine Pass Channel as primary contact recreation, secondary contact recreation, fish and wildlife propagation, and oyster production (LDEQ 2002). The Texas Commission on Environmental Quality (TCEQ) also evaluates Sabine Pass Channel in its Water Quality Inventory. TCEQ (2002) found that contact recreation, aquatic life, and general uses are fully supported within the estuary. According to the LDEQ, numerical nutrient data are as follows:

- chloride: None;
- sulfate: None;
- dissolved oxygen: 4.0;
- pH: 6.5 to 9.0;
- biologically activated carbon: 1;
- degrees Centigrade: 35; and
- total dissolved solids: None.

The channel's designated uses by the State of Louisiana have not been assessed in recent Louisiana Section 305b water quality inventories (LDEQ 2002). No sensitive surface waters occur within the Project's vicinity.

The Project would not cross any surface waterbodies containing contaminated sediments. A study by the National Oceanic and Atmospheric Administration (NOAA) that assessed sediment toxicity and chemical contamination in Sabine Pass Channel and Sabine Lake determined that toxicity of the sediments in the Project area was not significantly different from controls (Long 1999). The report concluded that sediment quality in the Sabine Lake area was not severely degraded (Long 1999).

Impacts and Mitigation

Stage 1

Construction and operation of Stage 1 would occur within the footprint of the existing SPLNG Terminal facility. Stormwater removal from within the liquefaction area would be directed to the north of the Project site to three drain pipes to be installed at the northwestern edge of the liquefaction area. Other areas of the site would be graded to divert stormwater into existing drainages that also discharge into the Sabine Pass Channel.

LNG piping would be hydrostatically tested to ensure structural integrity. Potable water would be used as the source for hydrostatic test water. No chemical additives would be used during hydrostatic testing and water would be tested for various water quality parameters in accordance with an LDEQ permit prior to discharging on site in a vegetated area in accordance with the hydrostatic test discharge permit issued by the LDEQ and Sabine Pass' Procedures. None of the discharged water would leave the Project site. To minimize erosion and scour, energy dissipation devices would be used.

Because major equipment would be delivered primarily by barge, improvements to the existing construction dock would be implemented. It is anticipated that maintenance dredging at the existing construction dock would be necessary to restore the required depth of 17 feet. During previous maintenance dredging events, approximately 30,000 cubic yards of silt was removed and placed for beneficial use in the wetland areas north of the Project area. The maintenance dredge activities are authorized under Nationwide Permit 35 (SWG-2004-00465) issued on March 10, 2008, and renewed on July 21, 2010, and Coastal Use Permit P20071705, issued by the LDNR. The Nationwide Permits are scheduled to be modified, reissued, or revoked prior to March 18, 2012. Sabine Pass has stated that it will re-apply for authorization for maintenance dredging prior to the permit's expiration.

In addition, potential impacts on waterbodies during construction would be minimized through adoption of methods described in Sabine Pass' Procedures. Also, Sabine Pass would follow guidelines outlined in its Spill Prevention, Control, and Countermeasures (SPCC) Plan, which is currently in place for the SPLNG Terminal. Prior to beginning construction, the SPCC Plan would be reviewed and modified, as appropriate, to include the liquefaction facilities.

We received comments regarding wastewater disposal from the demineralized water system and potential impacts and impairment of water quality. Approximately 30 percent of the water that enters the RO system for the creation of demineralized water would be rejected as wastewater. Based on current engineering design estimates, each train would require a maximum of 875 gpm of potable water entering into the RO system to create demineralized water. The RO system would reject approximately 285.2 gpm per train as wastewater.

The RO reject flow would still be considered potable water as noted in the compositions in Table 2.2-1. The RO reject water would be sent to the utility water storage tank and used as service water throughout the facility. Once the utility water tank becomes full, the RO reject water would be routed to the firewater pond were it would be diluted with the existing rainwater prior to discharging to the Sabine-Neches River at the existing LPDES permitted outfall. This existing outfall location has permit limits for total organic carbon, oil and grease, total suspended solids, and pH. The outfall is sampled monthly to maintain compliance with these permit limits. Most freshwater aquatic ecosystems involving mixed fish fauna can tolerate TDS levels of 1,500 milligrams per liter (mg/L). Brackish water ranges between 1,500 to 5,000 mg/L TDS, while saline water is greater than 5,000 mg/L. The RO reject water would have a TDS of approximately 560 mg/L, which is well within the tolerable limits for freshwater aquatic ecosystems. The increase in wastewater from the RO system would not impair the water quality of the Sabine-Neches River or result in impacts on aquatic ecosystems.

Table 2.2-1
Estimated Composition of the Reverse Osmosis Reject Water

Parameter	Value at 50°F	Value at 90°F
Calcium, mg/L	39.9	39.8
Magnesium, mg/L	13.6	13.6
Sodium, mg/L	96.5	95.3
Potassium, mg/L	10.7	10.6
Ammonium, mg/L	3.6	3.5
Barium, mg/L	0.227	0.226
Strontium, mg/L	0.381	0.38
Bicarbonate, mg/L	149.8	132.2
Sulfate, mg/L	89	101.5
Chloride, mg/L	112.8	111.8
Fluoride, mg/L	5.4	5.3
Nitrate, mg/L	1.3	1.2
Silica, mg/L	42.9	42.6
TDS, mg/L	566.2	558
pH	8	7.6

Ballast Water Discharge

Ballast water is water that is collected and carried by ships to provide balance, stability, and trim during transport. Ballast water is typically pumped into ballast tanks when a ship has delivered a cargo to a port and is departing with less cargo weight. We received several comments regarding ballast water discharge and impacts on aquatic resources in the port vicinity. Given that the ballast water would be approximately 50 percent of the weight of the LNG cargo to be loaded, the amount of ballast water to be unloaded during LNG cargo loading would range from approximately 7 to 15 million gallons for LNG carriers ranging in size from 125,000 to 266,000 cubic meters. In comparison, the approximate volume of water in the slip is 756 million gallons, such that the ballast water released would be approximately 1 and

2 percent of the water in the slip, which would not significantly affect the water quality of the slip. Further, the combined long-term median flow of the Sabine and Neches Rivers just upstream of Sabine Lake was 4,182,816 gallons per minute, meaning that in 1.7 to 3.5 minutes the same amount of water released as ballast would flow down the channel.

The majority of ballast water introduced into the SPLNG Terminal marine berth and the Sabine Pass Channel would be made up of open ocean water (Gulf of Mexico) retrieved during ballast water exchange (BWE) activities during trans-ocean shipping. During BWE, the water is withdrawn below the surface where salinities are typically higher than nearer the surface. Likewise in the SPLNG Terminal marine berth, ballast water is discharged below the surface where salinities are higher than at the surface, but not as high as that which can occur out in the Gulf of Mexico. Tidal exchange and increased freshwater runoff will dilute the ballast water discharge to salinity levels indistinguishable from those regularly occurring in the basin. Given the location of the marine berth and proximity to the Gulf and the fact that the surrounding waters are tidally influenced, ballast discharge would have negligible effects on the species in the area of the marine berth.

An additional physio-chemical water quality parameter that may be influenced by the introduction of ballast water is the dissolved oxygen level. Dissolved oxygen levels are an important aspect of the respiration of aquatic marine organisms. Dissolved oxygen levels in water can be influenced by many factors including water temperature, water depth, phytoplankton, wind, and current. In a water column profiles, there is a direct correlation in a decrease in dissolved oxygen relating to an increase in depth. Factors that influence this stratification include sunlight attenuation for photosynthetic organisms that can produce oxygen, wind, wave, and current that results in mixing. Currently, one guideline for meeting ballast water management guidelines regarding the spreading of noxious species is to lower the dissolved oxygen in the ballast water to eradicate the noxious organisms.

Water temperatures and pH are not likely to be altered as a result of introducing ballast water. Because ballast water is stored in the ship's hull below the waterline, water temperatures are not expected to deviate much from ambient temperatures of the surrounding seawater. The pH of the ballast water (reflective of open ocean conditions) may be slightly higher as compared to that of freshwater estuaries. The pH of saltwater ranges from 7.5 to 8.4, more often at approximately 8.2, while the pH of freshwater ranges from 6.5 to 8.0 and typical river water is in the range of 7 to 7.5. This slight variation between the seawater released from the ballast tanks and the river and estuary water in the marine berth is not expected to have any impacts on existing marine organisms.

Based on current federal and state regulations regarding ballast water discharge, there are no specific operational related permits required to discharge ballast water. Additionally, Sabine Pass has previously secured all necessary permits and approvals to construct and operate the SPLNG Terminal, including export of LNG that also requires discharge of ballast water (see Export EA in Docket Nos. CP04-47-001 and CP05-396-001). No modifications or ground/marine-related disturbances would occur; therefore no additional permits or clearances are required. Sabine Pass has consulted with the NOAA, USFWS, and LDWF regarding the Project. To date, none of these agencies has indicated a concern with this activity.

As part of its permit application for the approved LNG export activities, Sabine Pass was required to review and evaluate current and past applicable federal guidelines for ballast water exchange activities which included the following:

- <u>Non-indigenous Aquatic Nuisance Prevention and Control Act of 1990</u> (NANPCA) – Established a broad federal program "to prevent introduction of and to control the spread of introduced aquatic nuisance species…The USFWS, USCG, USEPA, USACE, and NOAA all were assigned . . . responsibilities, including membership on an Aquatic Nuisance Species Task Force. . . " (ANSTF 2005).

- National Invasive Species Act of 1996 (NISA) – Legislation that reauthorizes and amends the NANPCA 1990. "Non-indigenous invasive species have become established throughout the waters of the U.S. and are causing economic and ecological degradation to the affected near shore regions." The Secretary of Transportation was charged to develop national guidelines to prevent invasive species via ballast water of commercial vessels; the primary means of which is through mid-ocean BWE, unless the exchange threatens the safety or stability of the vessel, its crew, or its passengers (NEMW 2010a).
- National Aquatic Invasive Species Act of 2003 (NAISA) – Legislation amended in 2005 and again in 2007. The 2003 act established a mandatory National Ballast Water Management Program. The primary requirements established under NAISA are: 1) all ships operating in U.S. waters are required to have on board an Aquatic Invasive Species Management Plan, 2) the development of standards by the USCG for mid-ocean BWE and ballast water treatment (BWT) for vessels operating outside of the exclusive economic zone, 3) implementing the best management practices and available technology related to BWTs (USDA 2010).
- National Ballast Water Management Program (BWM) – Program originally established by NANPCA 1990 and further amended by NISA 1996 and NAISA 2003 resulting in the ballast water management program being made mandatory and to include BWE and reporting to the USCG (AAPA 2006).
- Shipboard Technology Evaluation Program (STEP) – Program authorized under the USCG BWM Program. STEP is designed to facilitate the development of "effective BWT technologies, through experimental systems, thus creating more options for vessel owners seeking alternatives to ballast water exchange." Applications to participate in the STEP program can be found on the USCG website under "STEP Application Instructions," at: http://www.uscg.mil/hq/cg5/cg522/cg5224/step.asp.
- Navigation and Vessel Inspection Circular 07-04, Change 1 – Program developed by the USCG for the management and enforcement of ballast water discharge into U.S. ports and harbors (33 CFR 151, 69 Federal Register 44952, July 28, 2004).

Based upon the above literature, rules and regulations, the vessels transiting to and from the SPLNG Terminal would operate in accordance with the federal oversight and regulations that govern ballast water discharge into U.S. waters. Additionally, upon entry into the SPLNG Terminal marine berth and as part of the SPLNG Terminal operating procedures, SPLNG Terminal marine staff would ensure and review any applicable documentation that the visiting ship is or has operating(ed) the vessel in accordance with the federal standards and practices prior to discharging any ballast water. Assuming that the ships that visit the SPLNG Terminal adhere to ballast water rules and regulations, no impacts to surface waters are anticipated.

Cooling Water

In order for the LNG carrier to maintain sufficient engine temperature, water would be recirculated during the loading or unloading process at berth. While unloading LNG, the carrier would run its engines to power onboard pumps that would move the LNG to or from the cargo tanks to the onshore facility. This type of operation requires less water than when the carrier is at sea. This scenario was previously evaluated during the review process of the original SPLNG Terminal and Expansion Projects under import and unloading conditions. The cooling water is withdrawn and discharged below the water line on the sides of the ship and the water that is discharged is typically 3 degrees Centigrade warmer than the source. The fact that the marine basin is significant in size and is in close proximity to the Sabine Pass Channel, it is anticipated that Channel flow and the heated water discharge by the LNG carrier would rapidly mix with the surrounding cooler water.

In addition, the LNG cargo loading rate is approximately the same as the LNG cargo unloading rate. However, the power demands on the LNG carriers' power plant are less during loading than unloading because the shore-side pumps would be used to transfer the LNG cargo from the storage tanks to the LNG carriers. Hence, less power would be required from the LNG carriers' power plant, which in turn, would result in the discharge of smaller quantities of cooling water.

Stage 2

Stage 2 work would occur within the footprint of the existing SPLNG facility. Stage 2 work would consist of installation of two additional LNG trains and additional infrastructure. Stage 2 components would be constructed and operated in the previously impacted construction workspaces of Stage 1. Therefore, the construction and operation of Stage 2 would have no further impacts to surface water resources than those discussed in Stage 1.

Stage 2 operation would double Sabine Pass' LNG production capacity from 8 mtpa after Stage 1 to a total of 16 mtpa. This would allow for an additional 69 to 147 LNG cargos for export. Stages 1 and 2 combined would result in up to 138 to 294 LNG cargo exports per year. Again, this would not result in an increase from the maximum number of ships already permitted (400) for the SPLNG Terminal.

Water Supply Pipeline

As part of operation of the Project, the liquefaction trains would use gas turbine-driven compressors which require standard annular combustors for nitrogen oxide (NOx) emissions control. NOx emissions control is achieved through injection of demineralized water, or steam injection. Operation of all four liquefaction trains would require a water supply of approximately 3,500 gpm. The existing SPLNG Terminal receives potable water from Johnson Bayou at a rate of 100 to 200 gpm. Therefore, an additional source of water would be required for the Project. Sabine Pass proposes to add a new water supply pipeline to supply both the service water and demineralized water systems.

The source of water for the new pipeline would be from the Port Arthur, Texas municipal water system, which is the only existing water system in the Project area currently capable of supplying the quantity of water required for the Project. Port Arthur draws surface water from the Neches River. The pipeline would begin at the Sabine Pass, Texas, water tower (to be constructed by the City of Port Arthur). Because the new water supply pipeline would be constructed beneath the Sabine Pass River, using HDD methodology, the only potential impacts associated with construction of the water supply pipeline may be due to a potential frac-out[3] of the bentonite drilling mud. Given the size, volume, flow, and tidal influence of the Sabine Pass Channel, any potential adverse effects due to a frac-out would be temporary and would be dispersed quickly. In the event of a frac-out, Sabine Pass would follow the HDD Drilling Mud/Frac-out Contingency Plan in Appendix A. We have reviewed this plan and find it acceptable.

2.2.2 Wetlands

Existing Environment

The existing wetlands in the Project area are palustrine emergent marsh. This system is characteristic of coastal wetland areas with close proximity to marine environments. The wetlands have previously served as dredge spoil areas and the resulting silt deposits have a high salt content. Representative plant species typically found in these emergent wetlands includes, but is not limited to, the following: marshhay cordgrass (*Spartina patens*), bushy bluestem (*Andropogon glomeratus*), bog rush (*Juncus marginatus*), sea oxeye (*Borrichia frutescens*), seashore paspalum (*Paspalum vaginatum*),

3 During normal drilling operations, drilling fluid travels up the borehole into a pit. When the borehole becomes obstructed or the pressure becomes too great inside the borehole, the ground fractures and fluid escapes to the surface. Such an event is described as a 'frac-out.'

flatsedge (*Cyperus* spp.), dewberry (*Rubus* spp.), saltgrass (*Distichlis spicata*), bulrush (*Scirpus robustus*), and soft rush (*Juncus effuses*). Figure 2.2-1 shows the wetlands surrounding the Project area.

The DMPAs are surrounded by berms and therefore the water level is dictated by groundwater influence and rain events. This dynamic environment has been limited by the absence of an established seed bank. The periodic reintroduction of sediment has limited the growth of any woody material and has therefore resulted in wetlands limited in diversity. These wetlands are similar in species distribution as many of the emergent palustrine wetlands along the lower Sabine River.

Impacts and Mitigation

Stages 1 and 2

Stage 1 impacts would occur entirely within the footprint of the existing SPLNG facility. The entire Project area for Stage 1 is comprised of unstable soils resulting as a product of dredge spoil placement. Stage 1 facilities would impact 73.6 acres of new wetlands, and Stage 2 would impact an additional 62.68 acres of wetlands, for a total of 136.28 acres of wetland impacts for Stages 1 and 2 combined. In addition, Sabine Pass would impact 19.88 acres of wetlands that were previously permitted and evaluated for construction of Tank 6. Given that the Project areas for Stage 2 would be utilized as construction work space and equipment storage areas for construction of Stage 1, Sabine Pass would stabilize both areas at the same time. Therefore, the Project would impact the total 136.28 acres of new wetlands due to Stage 1 and 2 construction and operation during construction of Stage 1 (see Figure 2.2-2 and Table 2.2-2).

Of the 136.28 acres of wetlands that would be impacted by the Project, 113.98 acres are wetlands that were created as mitigation for the previously authorized SPLNG Terminal (Mitigation Areas C, D, and F). The remaining 22.30 acres would be within an adjacent onsite wetland area not associated with mitigation pertaining to a previous permit. The majority of wetlands on site are previously altered from historic dredge operations within Sabine Pass.

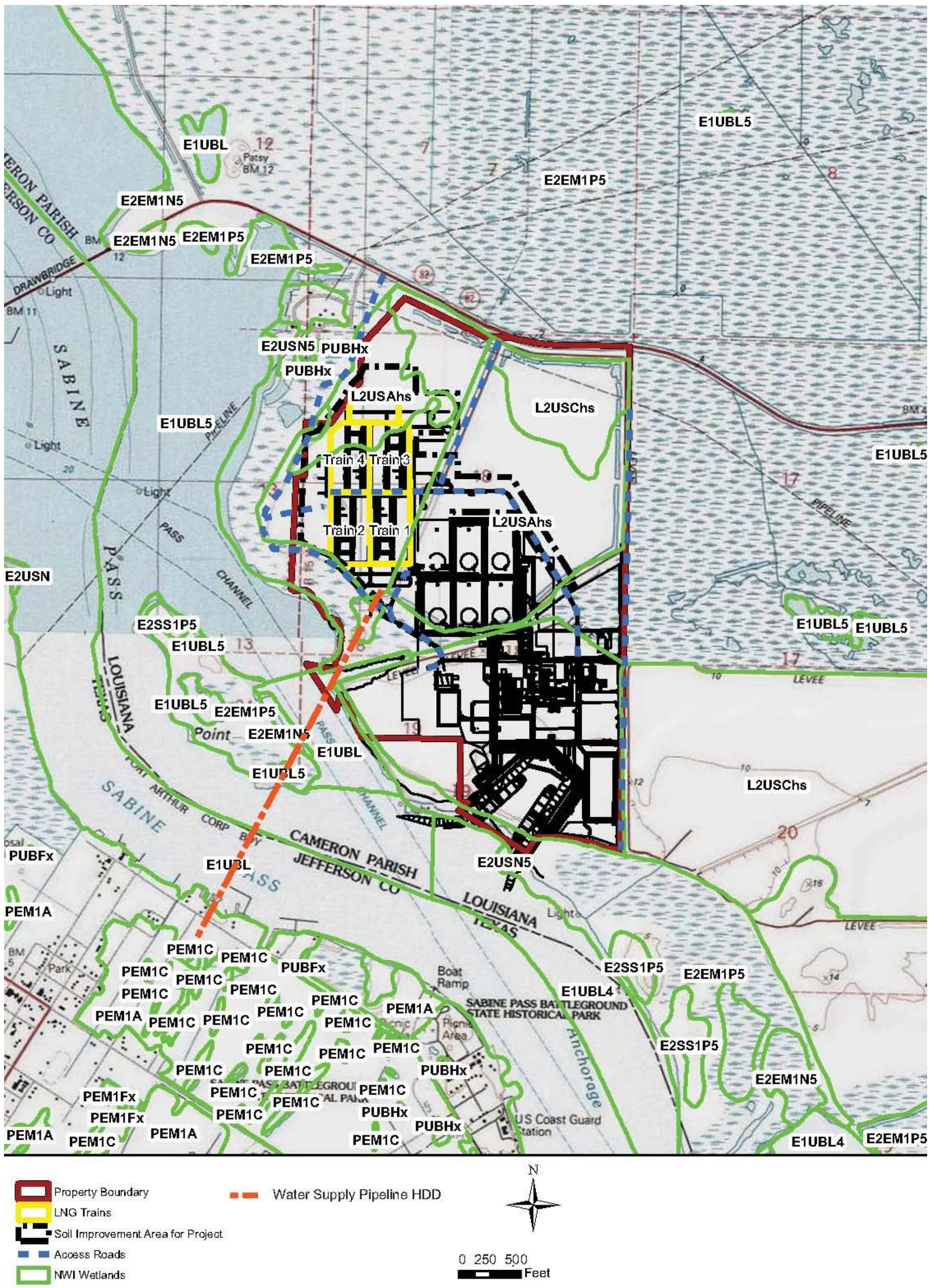
Sabine Pass proposes to fully mitigate for the 136.28 acres of wetlands that would be impacted by the Project, including impacts on Mitigation Areas C, D, and F, at the ratios discussed in its wetlands mitigation plan through the purchase of credits at a ratio of 1.2:1. This would result in 164.07-acre-credits to be purchased through the Petit Bois Mitigation Bank.

Table 2.2-2
New Wetland Impacts and Proposed Mitigation

Wetland Areas	Wetland ID	Wetland Acres Affected by the Liquefaction Project	Proposed Mitigation		
			Acres to be Mitigated	Approximate Ratio	Total
Mitigation Area C	Wetland 17	2.13			
Mitigation Area D	Wetland 16	4.13			
Mitigation Area F [(a)]	Wetland 16	107.72			
Non-Mitigation Area	Wetland 17	22.30			
Total:		**136.28**	136.28	1.2:1	164.07
Conversion of Mitigation Area F [(a)]		**72.24**	72.24	1.2:1	86.96
Total Mitigation Acres:			**208.52**	**-**	**251.03**

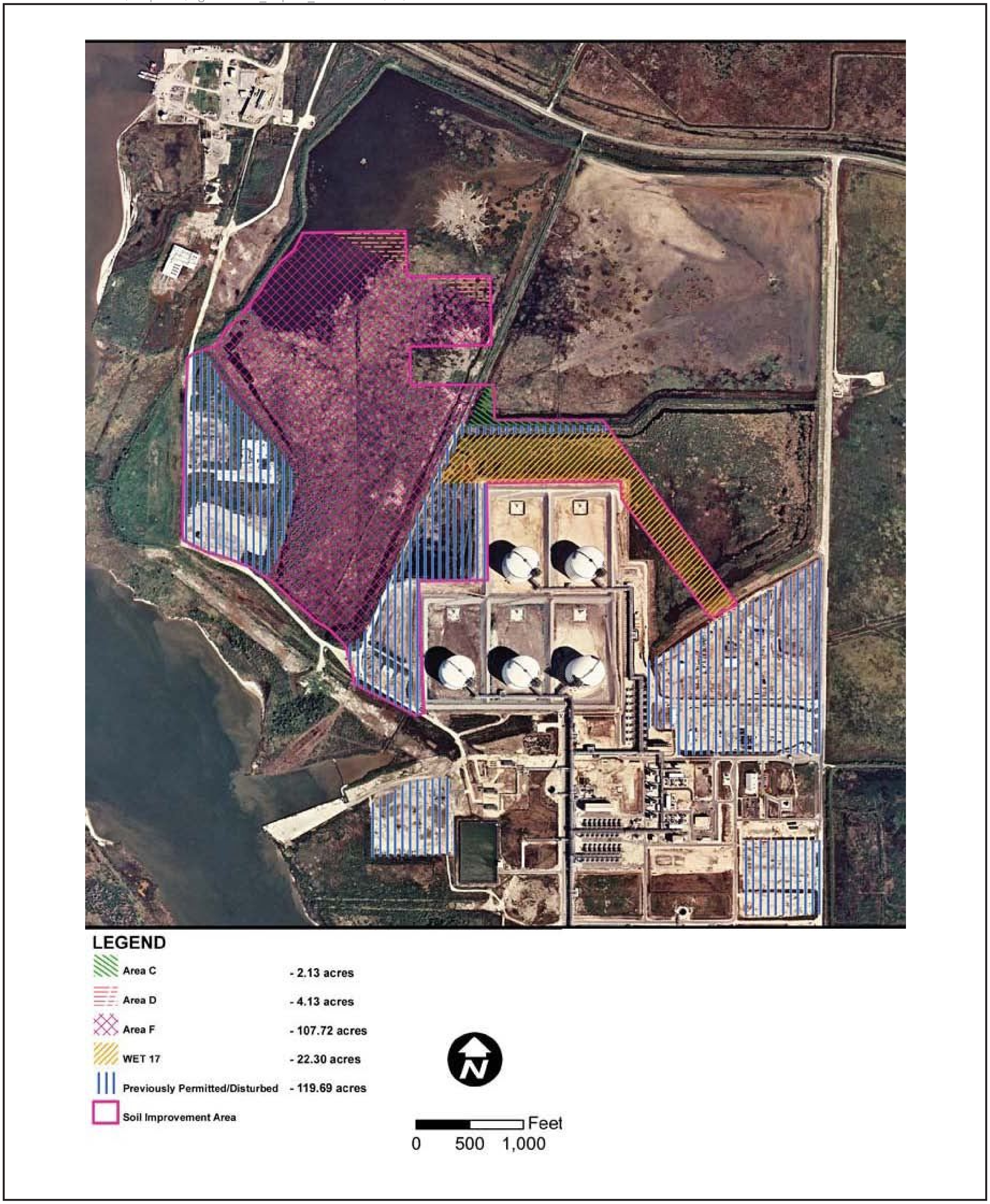
Note: (a) 72.24 acres of Mitigation Area F, which were created as mitigation for the previously authorized SPLNG Terminal, also would be mitigated to account for the loss of mitigation due to the Project construction.

02:003082.SP19.01\Graphics\Figure 2.2-1_Liquefaction Project_and_Water.cdr-8/10/11-GRA



SOURCE: Sabine Pass, 2011

Figure 2.2-1 Wetland Areas near Liquefaction Project and Water Supply Pipeline
Sabine Pass Liquefaction Project, Cameron Parish, Louisiana



SOURCE: Sabine Pass, 2011

Figure 2.2-2 Impact Areas
Sabine Pass Liquefaction Project, Cameron Parish, Louisiana

The Project would impact 2 percent of Mitigation Area C (2.13 acres of the original total 113.4 acres), 9 percent of Mitigation Area D (4.13 of the original total 46.5 acres), and 96 percent of Mitigation Area F (107.72 of the original total 112.02 acres). Wetland impacts from the SPLNG Terminal were originally mitigated at a 3:1 ratio for creation of Mitigation Areas C and D. With the reduction to the mitigation acreages due to the Project's impact, there would be no appreciable reduction in overall mitigation ratios. Therefore, Sabine Pass does not propose any additional mitigation for Mitigation Areas C and D to compensate for the loss of mitigation areas created as a result of the SPLNG Terminal.

Of the 107.72 acres impacted by the Project to Mitigation Area F, 72.24 acres were incurred as a result of the SPLNG Terminal Phase II Expansion Project. Sabine Pass proposes to mitigate for those impacts using a 1.2:1 ratio, resulting in 86.96 acres of additional credits that would be purchased at the Petit Bois Mitigation Bank.

Although the Project would be located in the Sabine Lake watershed, there are no existing wetland mitigation banks with available credits. Therefore, Sabine Pass would mitigate for the total 208.52 acres at a 1.2:1 ratio totaling 251.03 acres through the Petit Bois Mitigation Bank in the COE, New Orleans District. The Petit Bois mitigation bank is in the adjacent Calcasieu River Drainage Basin. The Project would result in a loss of wetlands in the Sabine Lake Watershed (which are currently low quality, disturbed wetlands) and mitigation would occur in higher functioned, higher value wetlands with bottomland hardwood vegetation.

Water Supply Pipeline

Sabine Pass' proposed potable water supply pipeline would be constructed approximately 20 feet below the Sabine Pass Channel using HDD methodology. The entry point on the east side of the river would be staged within the Project area following fill and soil improvements. The exit point and staging area on the west side of the river would be located entirely in upland area. The water supply pipeline would have no additional impact on the wetlands within the immediate Project area.

2.2.3 Groundwater Resources

Existing Environment

Groundwater resources associated with the site are described as a coastal lowlands aquifer system (Renken 1998). The system consists of discontinuous wedge-shaped sediment beds that overlie the Vicksburg-Jackson confining unit, and it underlies most of the Gulf Coastal Plains, extending from southern Texas to the Florida Panhandle. The system is used extensively for agricultural, commercial, industrial, and public/domestic water supplies (Renken 1998). The mapped hydrologic unit underlying the Project area is the Chicot aquifer, which extends from eastern Texas to the Atchafalaya River in south-central Louisiana (Louisiana State University AgCenter 2001). The Chicot aquifer in southwestern Louisiana is a USEPA-designated Sole Source Aquifer under Section 1424(e) of the Safe Drinking Water Act.

Dissolved solids concentrations in the coastal lowlands aquifer system are directly related to groundwater flow (Renken 1998). Generally, dissolved solids concentrations are lowest further inland, but the water becomes increasingly saline toward the coast, resulting in dissolution of aquifer minerals and mixing with seawater. Groundwater movement near the coast is sluggish and insufficient to flush saltwater from the aquifer. The primary chemical constituent in the groundwater varies from calcium bicarbonate inland and along the Mississippi River alluvial aquifer, to sodium bicarbonate inland and in the recharge zones, and sodium chloride near the coast within the Chicot aquifer (Renken 1998).

No groundwater withdrawal areas occur within a 0.5-mile radius of the Project area. The Project is remote from any residential potable water wells or public water supplies. Public wells are over 10 miles away from the Project site and the closest residence to the Project area is on the Texas side of the Sabine Pass Channel, more than 1 mile from the SPLNG Terminal facilities.

Impacts and Mitigation

<u>Stages 1 and 2</u>

Construction and operation of Stages 1 and 2 of the Project would occur within the footprint of the existing SPLNG facility and no adverse impacts would occur to groundwater resources in the immediate vicinity of the Project site. Project-related disturbance and site preparation for Stages 1 and 2 would occur during Stage 1. All water used by Sabine Pass would be supplied by local waterlines via the Johnson Bayou Water District and the new potable water line supplied by the City of Port Arthur. No impacts on groundwater are anticipated. There would be no groundwater withdrawals on the SPLNG facility grounds or in the immediate vicinity from the underlying Chicot aquifer therefore no impacts on groundwater are anticipated.

<u>Water Supply Pipeline</u>

The new water supply pipeline would be installed via HDD beneath Sabine Pass outlet. The pipeline would not approach the aquifer and the HDD would not affect groundwater storage areas. The HDD staging areas would be located entirely in uplands or within the footprint of the existing SPLNG facility. No impacts on groundwater are anticipated to result from installation of the water line.

2.3 Fisheries, Vegetation, and Wildlife Resources

2.3.1 Fisheries and Essential Fish Habitat

Existing Environment

Fishery resources in the vicinity of the Project are limited to warm water marine or estuarine habitats. Marshes and associated open-water habitats near the Project area provide important habitat (i.e., nursery, escape cover, feeding grounds) for a variety of freshwater and estuarine-dependent fish and shellfish. Species typical of low-salinity areas include largemouth bass, crappie, bluegill, gar, and blue catfish. Estuarine aquatic species are adapted to living in a dynamic environment supporting both freshwater near the source of the freshwater (0.5 ppt) and open seawater conditions (30 to 40 ppt) (Patillo, Rozas, and Zimmerman 1995). Species found in waters within the Project area that have high salinity include Atlantic croaker, spot, Gulf menhaden, bay anchovy, red drum, black drum, southern flounder, blue crab, Gulf stone crab, brown shrimp, and white shrimp.

In 1996, new habitat conservation provisions were added to the Magnuson-Stevens Fishery Conservation and Management Act that mandate the identification of Essential Fish Habitat (EFH) for managed species. EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 USC 1802(10)). According to the Gulf of Mexico Fishery Management Council (GMFMC, 1998), all estuaries and estuarine habitats in the northern Gulf of Mexico are considered EFH. This includes the berthing dock area at the SPLNG Terminal site. Eight species are listed by the GMFMC as managed fishery species that may occur within the Sabine Lake estuary, including brown shrimp, gray snapper, Gulf stone crab, pink shrimp, red drum, Spanish mackerel, spiny lobster and white shrimp. In a November 3, 2010, letter, the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) agreed with information presented in Sabine's Notice of Intent that the addition of liquefaction equipment would not impact areas designated as EFH or supportive of marine fisheries resources. NOAA Fisheries added that it had no additional comments to provide regarding issues that should be covered in this EA.

Impacts and Mitigation

<u>Stages 1 and 2</u>

Construction and operation of Stages 1 and 2 would occur within the footprint of the existing SPLNG Terminal facility and no adverse impacts would occur to fisheries or EFH. Potential temporary alterations in salinity resulting from ballast water discharge within the berthing area are possible, but the significance of this alteration would depend on tidal and freshwater inflow conditions that would occur during the discharge of ballast water. Even if this alteration in salinity occurs during contrasting conditions, impacts would be temporary and localized and would not be outside the optimal or tolerable ranges of the estuarine species known to occur within the marine berth. We believe project-related impacts on fishery resources would be temporary and insignificant.

Water Supply Pipeline

HDD would be used to install the water supply pipeline under the Sabine Pass Channel. As such, the only potential impacts associated with construction of the water supply pipeline may be due to a potential frac-out of the bentonite drilling mud. Given the size, volume, flow, and tidal influence of the Sabine Pass Channel, any potential adverse effects due to a frac-out would be temporary and would be dispersed quickly. In event of a frac-out, the Applicant would follow the HDD Drilling Mud/Frac-out Contingency Plan in Appendix A. We have reviewed this plan and believe it is adequate.

2.3.2 Vegetation

Existing Environment

The vegetation in the proposed Project area is limited to the emergent wetland species associated within the DMPA. A listing of representative plant species that occur in these emergent wetlands includes, but is not limited to, the following: marshhay cordgrass (*Spartina patens*), bushy bluestem (*Andropogon glomeratus*), bog rush (*Juncus marginatus*), sea oxeye (*Borrichia frutescens*), seashore paspalum (*Paspalum vaginatum*), flatsedge (*Cyperus spp.*), dewberry (*Rubus spp.*), saltgrass (*Distichlis spicata*), bulrush (*Scirpus robustus*), and soft rush (*Juncus effuses*).

Impacts and Mitigation

Stages 1 and 2

Construction and operation of Stages 1 and 2 would occur within the footprint of the existing LNG facility and would affect previously disturbed area vegetation, including wetland vegetation listed in Section 2.3.2.1 above. The primary impact of construction and operation of the proposed facilities would be the temporary alteration or permanent loss of 136.28 acres of emergent wetland vegetation within the former DMPA. The Applicant's revised Mitigation Plan would include mitigation for the 72.24 acres of wetlands created as part of Mitigation Area F, a mitigation area created as a result of wetland impacts from construction of the Sabine Pass LNG project, under DA Permit 23426. In total, the Applicant would mitigate for 208.52 acres at a 1.2:1 ratio, totaling 251.03 acres. Sabine Pass would address mitigation for this loss through the Petit Bois mitigation bank in the COE, New Orleans District.

Water Supply Pipeline

Impacts on vegetative communities as a result of the water supply pipeline would be limited to temporary work spaces associated with the HDD entry and exit points. These temporary work spaces would be located on previously disturbed sites used for industrial purposes and thus do not contain important habitat, cover, or foraging communities; therefore, impacts would be minimal.

2.3.3 Wildlife

Existing Environment

Terrestrial Wildlife

Emergent wetland habitats provide refuge for a variety of terrestrial and marshland vertebrates. Approximately five species of amphibians, 16 species of reptiles, 86 species of birds, and 10 species of mammals occur in similar habitats within the region (Gosselink, Cordes, and Parsons 1979). Due to a lack of diverse vegetative communities and high levels of human activity, industrial areas do not provide substantial forage or cover for wildlife.

Migratory Birds

Migratory birds are protected under the Migratory Bird Treaty Act ([MBTA] -16 U.S. Code 703-711) and Bald and Golden Eagles are additionally protected under the Bald and Golden Eagle Protection Act ([BGEPA], 16 USC 668-668d). Executive Order (EO) 13186 (66 Federal Register [FR] 3853) directs federal agencies to identify where unintentional take is likely to have a measurable negative effect on migratory bird populations and to avoid or minimize adverse impacts on migratory birds through enhanced collaboration with the USFWS. EO 13186 states that emphasis should be placed on species of concern, priority habitats, and key risk factors, and that particular focus should be given to addressing population-level impacts.

On March 30, 2011, the USFWS and the Commission entered into a Memorandum of Understanding (MOU) that focuses on avoiding or minimizing adverse impacts on migratory birds and strengthening migratory bird conservation through enhanced collaboration between the Commission and the USFWS by identifying areas of cooperation. This voluntary MOU does not waive legal requirements under the MBTA, BGEPA, the Endangered Species Act (ESA), the Federal Power Act, the NGA, or any other statutes and does not authorize the take of migratory birds.

Migratory birds follow broad routes called "flyways" between breeding grounds in Canada and the U.S. and wintering grounds in Central and South America. The SPLNG Terminal is at the western edge of the Mississippi flyway and the eastern edge of the Central flyway. The existing SPLNG Terminal does not currently provide preferred habitat for migratory or non-migratory birds, although the DMPA may provide some marginal habitat. In a letter dated September 28, 2010, Sabine Pass consulted with the USFWS regarding potential Project impacts on migratory birds and any mitigating actions that may be required. On October 5, 2010, the USFWS determined that the Project is not likely to adversely affect those resources. We agree with this determination.

Marine Wildlife

A number of marine mammals are commonly observed in the Gulf of Mexico, some species with a greater affinity to coastal, inshore waters, while others are more commonly observed offshore in deeper, pelagic waters. Many species also are commonly observed in shipping channels in Texas and Louisiana, the most common and prolific being the bottlenose dolphin (*Tursiops truncatus*). Enacted in 1972, the Marine Mammal Protection Act serves to protect all marine mammals, both in coastal waters and on the high seas. Twenty-nine (29) species of marine mammals, including the West Indian manatee (*Trichechus manatus*), have been observed in the Gulf of Mexico.

Impacts and Mitigation

Stages 1 and 2

Construction and operation of Stages 1 and 2 would occur within the footprint of the authorized facility and would have minimal effect on the area wildlife and their habitat. No beneficial or adverse impact would occur to the area wildlife because: 1) the site is fully encompassed by extensive areas that provide similar and ample habitats for terrestrial wildlife, and 2) there would be no overall increase in LNG ship traffic, or berthing facilities, as a result of the Project. As part of previous federal authorizations for the terminal, LNG carriers traveling to and from the LNG terminal would use established, well-traveled shipping lanes, thus reducing the potential for collisions.

As mentioned previously in Section 2.3.1, potential temporary alterations in salinity resulting from ballast water discharge within the berthing area are possible, but the significance of this alteration would depend on tidal and freshwater inflow conditions that would occur during the discharge of ballast water. However, species likely to occur within the SPLNG Terminal marine berth area are highly adapted to salinity changes and seawater is well within their tolerance range. Given that ballast water salinity would be within the salinity range tolerated by these species and ballast water would be discharged near the bottom of the waterway, any effects on salinity are expected to be temporary and localized, and are not expected to have any negative effects on the wildlife in and around the SPLNG Terminal. Similarly, ships would be moving into and out of the marine berth; as such, the amount of water displaced by the ship would be circulated into, around, and out of the berth, and would facilitate rapid mixing of any ballast water and flushing of the marine berth on a per ship basis.

It is also important to note that the LNG carrier would recirculate water to cool the engines while the LNG carrier is at the berth for both loading and unloading LNG. However, Sabine Pass anticipates the same rate to load a ship as to unload and therefore impacts due to cooling water should be no different than previously analyzed. Therefore, we believe the Project would not adversely affect wildlife.

Water Supply Pipeline

Construction and operation of the water supply pipeline would potentially affect wildlife resources as a result of the temporary use of approximately 2.7 acres of habitat for the HDD entry/exit workspaces. Because these areas are located within previously disturbed industrial areas with limited value to wildlife, no short- or long-term impacts on wildlife are anticipated.

2.3.4 Threatened and Endangered Species

Existing Environment

Federal agencies, in consultation with the USFWS, are required by Section 7 of the ESA to ensure that any action they authorize, fund, or carry out would not jeopardize the continued existence of a federally listed threatened or endangered species or species proposed for listing. As the federal lead agency, the FERC is responsible for the Section 7 consultation process with the USFWS. In accordance with Section 380.13(b) of FERC's Order 603, however, the Project sponsor is designated as FERC's non-federal representative for purposes of informal consultation with the USFWS. Sabine Pass, as FERC's designated non-federal representative under the informal consultation process, contacted the USFWS to request a list of federally listed or proposed species and designated or proposed critical habitats that may be present within the Project area.

Correspondence with the LDWF, the USFWS, and NOAA National Marine Fisheries (NOAA Fisheries) identified nine federally listed threatened or endangered species as potentially occurring in the Project area, including piping plover (*Charadrius melodus*), Gulf sturgeon (*Acipenser oxyrinchus desotoi*), smalltooth sawfish (*Pristis pectinata*), sperm whale (*Physeter macrocephalus*), and five species of sea turtles (Kemp's ridley sea turtle [*Lepidochelys kempii*], loggerhead [*Caretta caretta*], green [*Chelonia mydas*], hawksbill [*Eretmochelys imbricata*], and leatherback [*Dermochelys coriacea*]).

Impacts and Mitigation

Stages 1 and 2

Construction and operation of the Project would occur within the footprint of the existing SPLNG Terminal facility; therefore, no additional impacts (beneficial or adverse) on threatened or endangered species, or critical habitat, in the Project vicinity would occur. Although maintenance dredging associated with the construction dock would impact an additional 6 acres (approximately) of open water habitat, the impacts associated with this activity would be minimal, would occur in a previously disturbed area, and no significant loss of habitat is anticipated. It is important to note that the Applicant received authorization under COE Permit 23426 (01) issued on August 15, 2005, to dredge the construction dock to a depth of 17 feet. Maintenance dredging activities were authorized in COE Permit SWG-2004-00465 (former Permit 23426(01)), issued on March 10, 2008, and renewed on July 21, 2010. All existing Nationwide Permits are scheduled to be modified, reissued, or revoked by the COE prior to March 18,

2012. Sabine Pass would reapply for authorization for maintenance dredging to the required depth of 17 feet in advance of expiration of this permit.

The LDWF and USFWS have concurred (July 15, 2010 and October 14, 2010, respectively) with the finding that impacts would be minimal and that no significant loss of habitat is anticipated. In addition, the Applicant has provided LNG ship captains with NOAA Fisheries' "Vessel Strike Avoidance Measures and Reporting for Mariners" that outlines measures to avoid collisions with marine mammals (and sea turtles).

Sabine Pass has consulted with NOAA Fisheries regarding potential Project impacts on marine mammals and sea turtles. In a November 12, 2010 email, NOAA Fisheries stated that re-initiation of EFH consultation would not be necessary because the proposed Project would not substantially change marine traffic from its previous reviews conducted for the SPLNG Terminal (Croom 2010). Therefore, we have determined that the Project would not adversely affect any threatened or endangered species.

Water Supply Pipeline

Construction and operation of the water supply pipeline would potentially affect approximately 2.7 acres of land for the HDD entry/exit workspaces. Because these areas are located within previously disturbed industrial areas with limited value to wildlife, no short- or long-term impacts to threatened and endangered species are anticipated. Therefore, we have determined that the water supply pipeline would have no effect on threatened or endangered species.

2.4 Land Use, Recreation, and Visual Resources

2.4.1 Land Use and Recreation

Existing Environment

The proposed Project site, located in a rural area of Cameron Parish, Louisiana, currently has minimal municipal services, no potable water (except for that developed for the SPLNG Terminal), and is dominated by marshland. It is located entirely on private land; no public or conservation lands would be crossed by the Project. The nearest residences are across the Sabine Pass Channel in Sabine Pass, Texas. No planned residential or commercial areas are expected within 0.25 mile of the Project.

Recreational resources near the proposed Project site include boating and fishing in Sabine Lake and the Gulf of Mexico, and hunting in the marshlands adjacent to Sabine Lake and the Sabine Pass Channel. Active public boat launches are located on both the Texas and Louisiana sides of the Sabine Pass Channel, and an additional ramp is located at the Sabine Pass Battleground State Historic Park. Designated natural and recreational areas in the vicinity of the Project area include the Sabine Pass Lighthouse (approximately 3.1 miles from the Project) and the Sabine Pass Battleground State Historic Site (approximately 1.4 miles from the Project).

Impacts and Mitigation

Approximately 290.91 acres of the existing 853-acre SPLNG Terminal site would be affected by construction of the Project, of which 191.20 acres would be required for operation of the Project facilities. Table 2.4-1 summarizes the land use requirements associated with construction and operation of the Project.

Table 2.4-1 Land Use Affected by Construction and Operation of the Project (acres)						
	Industrial		**DMPA**		**Total**	
Facility	**Const.[(a)]**	**Oper.[(b)]**	**Const.[(a)]**	**Oper.[(b)]**	**Const.[(a)]**	**Oper.[(b)]**
Soil Improvement Area	54.92	54.92	136.28	136.28	191.2	191.2
Previously Disturbed Industrial Areas	97.01	0	0	0	97.01	0
Water Supply Pipeline Areas	**2.7**	**0**	**0**	**0**	**2.7**	**0**
Total	**154.63**	**54.92**	**136.28**	**136.28**	**290.91**	**191.2**

Notes:
(a) Construction area includes the entire construction footprint, including previously disturbed/converted industrial areas and 12.84 acres for the sixth LNG tank (S-106), approved in Docket CP05-396-000 et al., and within the soil improvement area.
(b) Operational area includes only new area being converted to industrial use for the permanent Project facilities.
Key:
DMPA = Dredge material placement area.

Table 2.4-2 outlines the proposed and existing access roads to be used during construction and operation of the project and their status. The existing levee road would be improved to allow a 20-foot travel lane for construction equipment accessing the construction area. A total of 3.08 new acres of road would be constructed. None of these areas would affect wetlands.

Table 2.4-2 Access Roads Used for Construction and Operation of the Project			
Access Road	**Approximate Length (miles)**	**Current Status**	**Acres[(a)]**
Lighthouse Road (west)	1.53	Existing plant road	3.71
Duck Blind Road (east)	1.58	Existing plant road	3.83
Spur 1 from Duck Blind Road	0.15	New	0.36
Spur 2 from Duck Blind Road	0.17	Existing	0.41
Liquefaction Road	1.12	New	2.72
DMPA Levee Road[(b)]	0.5	Existing levee	4.91
Total	**5.05**	**-**	**15.94**

Notes:
(a) Impacts are based on a width of 20-feet for each access road, except for the DMPA Levee Road.
(b) The DMPA Levee Road will require soil improvement to support construction equipment and impacts are based on the existing width of the levee, which is approximately 80 feet wide.

<u>Stage 1</u>

Construction and operation of Stage 1 of the Project would occur within the footprint of the existing SPLNG Terminal facility. Sabine Pass had indicated that areas for Stage 2 facilities would be utilized as construction workspace and equipment laydown for construction of Stage 1 to minimize the footprint of the Project. Overall, 136.28 acres of land would be converted to industrial land use during construction of Stage 1.

Stage 2

Construction and operation of Stage 2 would occur within the footprint of the existing SPLNG Terminal facility and would the areas proposed for construction in Stage 2 would be converted to industrial use during Stage 1 Project construction. Construction activities would have no impact on existing land use and recreational activities in the immediate vicinity as construction would be within the existing SPLNG Terminal facility footprint and would be consistent with current uses.

Water Supply Pipeline

The 1.2-mile-long, potable water pipeline under the Sabine Pass River and Channel would be horizontally directionally drilled 20 feet below the existing channels (at a depth of approximately 70 feet from the water surface). The HDD entry point would occur on previously disturbed industrial land in the Sabine Pass, Texas. The HDD exit point would occur in an industrial upland area within the existing SPLNG Terminal, near the proposed Project facilities site. The HDD entry and exit workspaces would be temporary and would be located within industrial land, measuring approximately 150 feet by 150 feet.

Once the HDD is complete, the drill exit workspace would be allowed to revert to preconstruction contours and elevations. The HDD entry and exit workspaces would be accessed via existing roads and no additional temporary access roads or staging areas would be necessary. In addition, there would be no adverse impacts to the current uses of the Sabine Pass River or the Sabine Pass Channel during construction or operation of the water supply pipeline as no dredging or water-based construction would be required.

2.4.2 Coastal Zone Management

The Project would be located entirely within a coastal zone management area. In Louisiana, the Coastal Zone Management Plan is administered by the Coastal Management Division of the LDNR. Sabine Pass would be required to submit a Coastal Use Permit application to the Coastal Management Division concurrent with the COE Section 404 permit application. However, Louisiana Administrative Code (LAC) Title 43:I.1.7.C§723.B.2.a does not require a coastal use permit if activities occur on land that is 5 feet or more above sea level.

Stages 1 and 2 would be located wholly on property that has been improved for industrial use and adjacent wetlands. Elevations within these areas range from 9 to 17.5 feet above MSL. As stated previously, construction of the water supply pipeline would be completed utilizing HDD methodology. This technique occurs below the waterline at depths that preclude impacts to coastal resources. On March, 28, 2011, the proposed Sabine Pass Liquefaction Project activities (Stage 1, Stage 2, and Water Supply Pipeline Construction) were authorized under existing Coastal Use Permits GP-14 (water line) by the LDNR Office of Coastal Zone Management and an additional Coastal Use Permit is not required. No adverse impacts are anticipated to occur to area coastal zone resources.

2.4.3 Visual Resources

Existing Environment

The proposed Project site is in an undeveloped part of Cameron Parish where there are no residences or schools that would be within the viewshed of the Project facilities. Project components that could have a visual impact on surrounding areas are the four liquefaction trains and associated facilities. These facilities would include 32 exhaust stacks from the refrigerant compressor gas turbine drivers and generators, each measuring approximately 212 feet by 7.5 feet at the discharge, and three flare towers that would be approximately 312 feet in height.

Potential public viewpoints include public boat ramps on both sides of the SH 82 bridge north of the SPLNG Terminal site, as well as the community of Sabine Pass and the Sabine Pass Battleground

State Historic Site on the west side of Sabine Pass Channel in Sabine Pass, Texas. No residences or schools that would be considered visually sensitive are within the proposed Project viewshed.

Impacts and Mitigation

Stages 1 and 2

Construction and operation of Stage 1 of the Project would occur within the footprint of the existing SPLNG Terminal facility. SPLNG Terminal facilities are presently part of the visual environment. The terrain is generally flat, vegetation is relatively low profile, and only intermittent views of the SPLNG Terminal are available to motorists and boaters. The proposed Project facilities would be visible, or partially visible, only to motorists using SH 82, boaters in the Sabine Pass Channel, boat ramp users, or park attendees. The public boat ramps are located to the north of both the Texas and the Louisiana sides of the SH 82 Sabine Pass bridge, which obstructs most of the view south of these positions. In addition, the Texas shore of Sabine Pass is largely industrial, and while there are no other facilities of this size on the Louisiana shoreline, the visual impact would be less than that of the facilities along the Texas shoreline. As illustrated on Figure 2.4-1, the addition of the new Project facilities associated with Stages 1 and 2 would result in minimal impacts to aesthetics of the area.

Water Supply Pipeline

Construction of the 1.2-mile water supply pipeline would include an entry point at the Sabine Pass Texas, water tower and an exit point within the existing SPLNG Terminal near the proposed Project facilities. There would be no visual or aesthetic impacts within the Sabine Pass River or Sabine Pass Channel as a result of the water supply pipeline construction or operation as the HDD activities would occur approximately 20 feet below the existing channel depth of -45 feet so as not to interfere with navigation. The drill exit workspace would be temporary and would be located within existing upland industrial land measuring approximately 150 feet by 150 feet. Once the HDD is complete, the drill exit workspace would be allowed to revert to pre-construction contours and elevations. The associated onshore facilities would be a part of the existing industrial visual environment and would not create an additional visual or aesthetic impact.

2.5 Socioeconomics

2.5.1 Existing Environment

Population, Employment, and Housing

Table 2.5-1 provides selected population and demographic statistics for the Project area. The statistics presented in Table 2.5-1 represent the latest available data from the last two comprehensive censuses, Census 2000 and Census 2010. Cameron Parish's population decreased from 9,988 in 2000 to 6,839 persons in 2010, a 32% decline. In 2010, population density, an indicator of the extent of development, was 5.2 persons per square mile in Cameron Parish, compared to the state average of 104.1 persons per square mile.

View of Existing Sabine Pass Facilities taken from Walter Umphrey State Park

Artist's Rendering of Proposed New Facilities (View from Walter Umphrey State Park)

View of Existing Sabine Pass Facilities taken from Louisiana State Highway 82, Approximately 0.6 miles from Sabine Pass Terminal entrance road

Artist's Rendering of Proposed New Facilities (view from Louisiana State Highway 82, approximately 0.6 miles from Sabine Pass Terminal entrance road)

SOURCE: Sabine Pass, 2011

Figure 2.4-1 Artist's Rendering of Proposed New Facilities
Sabine Pass Liquefaction Project, Cameron Parish,

Table 2.5-1 Existing Population and Demographic Characteristics of the Project Area				
Demographic Characteristics	**Louisiana**	**Cameron Parish, LA**	**Calcasieu Parish, LA**	**Jefferson County, TX**
2000 Census Population	4,468,958	9,988	183,577	252,052
2010 Census Population	4,533,372	6,839	192,768	252,273
Population Change 2000 - 20010 (percent)	1.4	-31.5	5.0	<1
2010 Population Density (persons per square mile)	104.1	5.2	180.0	279.2
Persons per Household (2010)	2.52	2.56	2.52	2.50
Source: U.S. Census Bureau 2010. Note: Louisiana state data are shown to provide a comparison to the data for Cameron Parish, which includes the Project site.				

Calcasieu Parish's population grew from 183,577 persons in 2000 to 192,768 persons in 2010, a 5% increase. Jefferson County's population increased less than one percent from 252,052 persons to 252,273 persons from 2000 to 2010. Population density was 180.0 persons per square mile in Calcasieu Parish and 279.2 persons per square mile in Jefferson County, Texas, in 2010.

Table 2.5-2 provides employment and income statistics for the Project area. Education, health, and social services represent the major industry in the overall Project area; although the major industry in Cameron Parish, where the SPLNG Terminal is located, is professional, scientific, management, administrative, and waste management services. Cameron Parish has a civilian labor force of 4,130 persons, and per capita income in the parish is $25,681 (U.S. Census Bureau n.d.). The parish has a lower percentage of population below the poverty level and a lower unemployment rate than the state. Calcasieu Parish has a civilian labor force of 90,357 persons, and per capita income in the parish is $23,514 (U.S. Census Bureau n.d.). Calcasieu Parish also has a lower percentage of population below the poverty level and a lower unemployment rate than the state. Jefferson County has a civilian labor force of 109,357 persons, and per capita income in the county is $21,670 (U.S. Census Bureau n.d.). Within the Project area, Jefferson County has the highest percentage of population below the poverty level and the highest unemployment rate (excluding the state of Louisiana data). Based on the 2010 unemployment rate, approximately 18,500 persons are unemployed in the Project area.

Table 2.5-2 Employment and Income Characteristics of the Project Area				
	Louisiana	**Cameron Parish, LA**	**Calcasieu Parish, LA**	**Jefferson County, TX**
Major Industry	Education, health, and social services	Professional, scientific, management, administrative, and waste management services	Education, health, and social services	Education, health, and social services
2005-2009 Civilian Labor Force	2,095,192	4,130	90,357	109,357
2005-2009 Per Capita Income (dollars)	22,535	25,681	23,514	21,670
2005-2009 Population	18.4	8.1	16.5	18.0

Table 2.5-2 Employment and Income Characteristics of the Project Area				
	Louisiana	**Cameron Parish, LA**	**Calcasieu Parish, LA**	**Jefferson County, TX**
Below Poverty Level (percent)				
2010 Unemployment Rate (percent)	7.5	6.2	7.0	10.9

Sources: U.S. Department of Labor, Bureau of Labor Statistics 2010; U.S. Census Bureau n.d.
Note:
The U.S. Census Bureau's 2005 - 2009 American Community Survey Five-Year Estimates are based on data collected over a five-year period. The estimates present average socioeconomic characteristics over this timeframe, rather than characteristics at a single point in time.

Table 2.5-3 shows the rental and other temporary housing options (hotels, motels, campgrounds, and recreational vehicle [RV] parks) in the Project area, including Sulphur, Louisiana, and Port Arthur, Texas, as of 2010. Vacant housing units in Cameron Parish totaled 1,018 units; of these, 62 units were for rent and 770 were for seasonal, recreational, or occasional use (U.S. Census Bureau 2010). In Calcasieu Parish, vacant housing units totaled 8,062 units; of these, 3,015 units were for rent and 724 units were for seasonal, recreational, or occasional use. Approximately 16% of the vacant units for rent and 5% of the vacant units for seasonal, recreational, or occasional use in Calcasieu Parish are located in Sulphur. Jefferson County had a total of 104,424 housing units in 2010. A total of 10,983 units were vacant; of these, 4,380 were for rent and 973 were for seasonal, recreational, or occasional use (U.S. Census Bureau 2010). Approximately 28% of the vacant units for rent and 31% of the vacant units for seasonal, recreational, or occasional use in Jefferson County are located in Port Arthur.

There are nine hotels and motels and nine campgrounds and RV parks in Cameron Parish (Yellow Book 2011). In the adjacent localities of Sulphur, Louisiana, and Port Arthur, Texas, there are a total of 64 hotels and motels and 17 campgrounds and RV parks (Yellow Book 2011). Additional hotels/motels and campgrounds/RV parks are located in Calcasieu Parish and Jefferson County. No residential or other structures are located within 50 feet of the Project site.

Table 2.5-3 Temporary Housing in the Project Area						
	Louisiana	**Cameron Parish, LA**	**Calcasieu Parish, LA**	**Sulphur, LA**	**Jefferson County, TX**	**Port Arthur, TX**
Total Housing Units (Occupied and Unoccupied)	1,964,981	3,593	82,058	9.053	104,424	23,577
Number of Renter Occupied Housing Units	566,061	315	22,463	2,615	34,375	8,050
Vacant Housing Units	236,621	1,018	8.062	954	10,983	3,394
For Rent	66,857	62	3,015	489	4,380	1,237
Rented, Not Occupied	3,273	4	132	12	171	57
For Sale Only	21,480	30	726	90	1,108	272
Sold, Not Occupied	7,294	4	278	18	528	162
For Seasonal, Recreational, or Occasional Use	42,253	779	724	35	973	299

Table 2.5-3 Temporary Housing in the Project Area						
	Louisiana	**Cameron Parish, LA**	**Calcasieu Parish, LA**	**Sulphur, LA**	**Jefferson County, TX**	**Port Arthur, TX**
All other vacants	95,464	139	3,187	310	3,823	1,367
Homeowner Vacancy Rate (percent)	1.8	1.3	1.4	1.6	1.8	2.2
Rental Vacancy Rate (percent)	10.5	16.3	11.8	15.7	11.3	13.2
Number of Hotels/Motels [(a)]	3,269	9	78	27	108	37
Number of Campgrounds and RV Parks [(a)]	406	9	31	11	25	6

Sources: U.S. Census Bureau 2010; Yellow Book 2011.
Notes:
(a) YellowBook, 2010: Number of "Hotels and Motels" and "Campgrounds and RV Parks" as advertised on www.yellowbook.com. Actual numbers may vary.

Economy and Tax Revenue

Table 2.5-4 provides information on receipts in various industries in the Project area documented in the 2008 economic census (U.S. Census Bureau 2008). Within the Project area, the manufacturing, wholesale trade, retail, and accommodation and food service industries are larger (measured by receipts) in Calcasieu Parish and Jefferson County than Cameron Parish. Data for the manufacturing and wholesale trade industries in Cameron Parish were withheld to avoid disclosing data for individual companies.

Table 2.5-4 Existing Income and Employment Conditions in the Project Areas				
Income Characteristic	**Louisiana**	**Cameron Parish, LA**	**Calcasieu Parish, LA**	**Jefferson County, TX**
Manufacturers' Receipts, 2008 ($1000)	192,530	Withheld [(a)]	4,334	7,032
Wholesale Trade Receipts, 2008 ($1000)	360,841	Withheld [(a)]	14,528	11,788
Retail Receipts, 2008 ($1000)	1,104,879	2,217	65,923	62,422
Accommodation and Food Service Receipts, 2008 ($1000)	283,884	206	10.777	10,789

Source: U.S. Census Bureau 2008.
Note: (a) Data were withheld to avoid disclosing data for individual companies.

Table 2.5-5 reflects the government revenues from ad valorem and sales taxes; permits, fees; and other revenue sources, as well as expenditures for administration, fire, police, community services, etc. The primary sources of revenues are special revenue funds in Cameron Parish (62%), intergovernmental transfers in Calcasieu Parish (92%), and property taxes (57%) and sales taxes (26%) in Jefferson County.

Table 2.5-5 Parish/County Revenues and Expenditures (dollars)			
Income Characteristic	**Cameron Parish, LA [(a)]**	**Calcasieu Parish, LA [(b)]**	**Jefferson County, TX [(c)]**
Revenues	13,148,369	13,297,000	119,643,726
Expenditures	15,555,338	13,569,383	113,606,176

Notes:
(a) Budget 2011 adopted by the Cameron Parish Policy Jury.
(b) Actual 2009 Budget reported in The Police Jury, Calcasieu Parish, Louisiana Annual Budget, 2011.
(c) Actual 2008 – 2009 Budget Reported in Jefferson County, TX Annual Budget Fiscal Year 2010 – 2011.

Public Services and Transportation

Table 2.5-6 summarizes local community public services in the Project area. Local communities typically have adequate infrastructure and community services, such as police, fire, and medical to accommodate the parish and county populations. The SPLNG Terminal has 24-hour onsite security, which would minimize the terminal's reliance on local law enforcement. The terminal also has an onsite firewater pond and pumps with sufficient capacity to respond to fire events.

Table 2.5-6 Public Service Data for the Project Area					
Parish/County, State	**Number of Public Schools**	**Number of Police Departments**	**Number of Fire Departments (by type)**	**Number of Hospitals**	**Number of Hospital Beds**
Cameron Parish, LA	6	1	1 (Career) / 6 (Volunteer)	1	49
Calcasieu Parish, LA	59	7	6 (Career) / 10 (Volunteer)	10	1,011
Jefferson Parish, TX	82	7	8 (Career) / 2 (Volunteer)	6	1,342

Sources:
American Hospital Directory 2010; Fire Departments Directory 2010; Louisiana Department of Education, 2011; Louisiana Hospital Assoc. 2010; Louisiana Interagency Coordination Center 2010; Public School Review 2010; Texas Education Agency 2011; UCompare Health Care. 2011a,b,c. USA Cops 2010.

Note: Hospitals do not include rehabilitation, long-term, and psychiatric hospitals.

Table 2.5-7 profiles school districts and enrollment within the Project area. In the 2009-2010 school year, 74,710 students were enrolled in 154 schools in the Project area.

Table 2.5-7 School Districts and School Enrollment in Project Area			
Parish/County	**Number of School Districts**	**Number of Schools**	**Total Enrollment**
Cameron Parish, LA	1	4	1,321
Calcasieu Parish, LA	1	63	32,905
Jefferson County, LA	6	87	40,484
Total	**8**	**154**	**74,710**
Source: National Center for Education Statistics 2010			

Public highways in the vicinity of the Project include SH 82 and SH 27. Access to the interstate highway system from the Project is provided by U.S. Route 69/96 in Port Arthur, which connects to Interstate 10 (I-10) in Beaumont. Alternately, I-10 can be accessed in Lake Charles, Louisiana, via SH 82 to SH 27. I-10 is approximately 30 miles north of the SPLNG Terminal.

SH 82, a two-lane highway, is classified as a major collector roadway by the Louisiana Department of Transportation and Development (LDOTD). The LDOTD estimates annual average traffic counts for SH 82 at two locations, near the Project and in the Holly Beach community at the junction of SH 82 and SH 27 (24 miles east of the SPLNG Terminal). Recent estimated annual average traffic counts for the highway are listed in Table 2.5-8.

Table 2.5-8 Recent Estimated Annual Average Daily Traffic Counts for State Highway 82		
Annual Average Daily Traffic Count by Year	**State Highway 82 near the Sabine Pass Liquefied Natural Gas Terminal**	**State Highway 82 in Holly Beach**
2007	1,838	2,098
2004	1,691	1,679
2001	1,187	1,271
1998	1,641	1,543
Source: LDOTD 2010.		

Barge access to the SPLNG Terminal is provided by the Intercoastal Waterway and the Sabine Pass Ship Channels. The nearest airport to the SPLNG Terminal is located 16.4 miles west in Port Arthur, Texas. The nearest heliport is in Sabine Pass, Texas, about 2 miles south of the Project location.

2.5.2 Socioeconomic Impacts

We received multiple comments during the open house and in comment letters regarding the Project's impact on employment and the economy within the Project area. This section provides the anticipated impacts on socioeconomic factors from the Project.

Population, Employment, and Housing

The Project would employ both local and non-local workers. Additionally, Sabine Pass would hire new permanent employees to operate the new facility. The creation of temporary and permanent jobs would have both a short- and long-term beneficial impact on employment in the Project area with an estimated 60 percent of the work force being hired locally. The Project would have a minor long-term effect on population in the Project area and a minor, long-term beneficial effect on housing in the Project area. The Project area has previously accommodated similar sized workforces associated with construction of the SPLNG Terminal, and the adjacent Golden Pass LNG Terminal, simultaneously.

Table 2.5-9 summarizes the construction and operational workforces associated with the Project. Construction of the facility would occur in two stages. Stage 1 would occur over 52 to 55 months; Stage 2 would require a similar amount of time to construct as Stage 1 but would be offset to allow workers to move from construction of one train to the next.

Table 2.5-9
Summary of Peak Construction and Operational Workforce

Parameter	Stage 1	Stage 2`
CONSTRUCTION		
Average Construction Workforce	1,200	1,200
Peak Construction Workforce (craft workers)	2,500 [(a)]	2,200 [(a)]
Peak Construction Workforce (supervisory staff)	200	175
Locally Hired Workforce	1,620 (60 %)	1,425 (60 %)
Non-Locally Hired Workforce	1,080 (40%)	950 (40%)
Estimated Construction Payroll	$525 Million	$470 Million
OPERATION		
Additional Operational Workforce	110 - 150	
Estimated Annual Operational Payroll	$17,571,000	
Planned Duration of Operation	20 years	

Note:
(a) Represents the total Project peak construction workforce, anticipated to occur in month 37 of Stage 1 construction and month 27 of Stage 2 construction.

During Stage 1, Sabine Pass would employ an average construction workforce of 1,200 and a peak month construction workforce of approximately 2,500 craft workers and 200 supervisory staff. During Stage 2, Sabine Pass would employ an average construction workforce of 1,200 and a peak month construction workforce of approximately 2,200 craft workers and 175 supervisory staff.

Approximately 60 percent of the construction workforce for both stages would be hired locally or within daily commuting distance of the SPLNG Terminal, if available. Local hires would include surveyors, welders, equipment operators, and general laborers. Construction personnel hired from outside the Project area would typically include pipeline construction specialists, supervisory personnel, and inspectors. Sabine Pass would add between 170 and 250 permanent employees to operate the completed facility.

Between 2006 and 2008, the Project area included a total civilian labor force of 213,925 persons, of which approximately 19,786 persons (9.3% of the civilian labor force) were unemployed. At the peak of construction during Stage 1, the Project would provide 1,620 local jobs and, at the peak of construction during Stage 2, the Project would continue to provide 1,425 local jobs. The jobs identified for Stages 1 and 2 are not additive. Sabine Pass anticipates offsetting construction of Stage 2 six to nine months from Stage 1. Many of the personnel hired under Stage 1 would continue to perform their same responsibilities for Stage 2. For example, a locally hired welder would likely start on Stage 1, Train 1, move to Train 2, then move to Stage 2, Train 3, and then Train 4. The unemployment statistics for the Project area indicate that the civilian labor force could provide workers to fill the expected number of local jobs. In addition, operation of the completed facility would result in the creation of 170 to 250 new permanent jobs, which could be filled by the local civilian labor force. Given the above, the Project would have both short- and long-term beneficial impacts on employment in the Project area.

Non-local construction personnel would temporarily relocate to the Project area for the duration of their work on the Project. Non-local construction personnel would compose approximately 40 percent of the workforce, or a peak of 1,080 personnel during Stage 1 and a peak of 950 personnel during Stage 2. Should non-local workers relocate with their families, a total of 2,830 persons (or less than 1 percent of the total population in the Project area) could temporarily relocate into the Project area. This assumes that all non-local workers would bring their families with them and each family would consist of 2.62 persons (the 2000 Census statistic of 2.62 persons per household in Louisiana). It is unlikely that all of the non-local construction personnel would bring their families with them. Therefore, the estimate of an in-migrating short-term population of 2,830 persons at the peak of construction is conservative, and actual in-migration could be less and would be distributed over the duration of construction.

Between 170 and 250 personnel could permanently relocate to the Project area following completion of construction. These operational personnel would likely relocate with their families. Assuming a household size of 2.62 persons, a total of 445 to 655 persons (an increase of less than 1 percent over the existing population in the Project area) could relocate to the Project area following completion of construction. Actual in-migration to the Project area could be less, given that some of the permanent jobs would likely be filled by workers currently residing in the Project area.

Temporary housing in the Project area, including rental housing, hotels/motels, and RV parks and campgrounds (summarized in Table 2.5-3), is expected to be sufficient to accommodate the peak non-local workforce of 1,080 personnel. Competition for hotels/motels and campsites may occur during the peak tourist seasons depending on the tourist attraction (e.g., hunting in the fall and recreation in the summer). In addition to the temporary housing listed in Table 2.5-3, it is likely that temporary RV parks would be erected in Johnson Bayou to accommodate construction personnel, as was done during construction of the SPLNG Terminal. Due to the relatively small in-migrating construction workforce and the availability of various types of temporary housing in the Project area, potential minor adverse short-term impacts on housing resources in the Project area are expected.

In addition, some of the 170 to 250 new permanent jobs that would be created as a result of the Project would likely be filled by workers currently residing within the Project area. Given the number of vacant housing units in the Project area (approximately 21,460 units, not including those for seasonal, recreational, or occasional use), it is expected that the Project would have a long-term beneficial impact on housing resources in the Project area by slightly reducing vacancy rates.

Because all construction would occur within the existing boundary of the SPLNG Terminal, the Project would not require displacement of any residences or businesses. No residential or other structures are located within 50 feet of construction work areas.

Economy and Tax Revenue

Stage 1 of construction would generate an estimated $400 million in craft labor wages and $125 million in supervisory wages ($525 million total). Stage 2 of construction would generate an estimated $360 million in craft labor and $110 million in supervisory wages ($470 million total). Some portion of the construction payroll would be spent in the Project area by both local and non-local workers. Because local workers currently spend money in the Project area, most of the short-term economic benefit would come from spending by non-local workers. The dollar amount of spending by non-local workers would depend on the numbers employed at any given time and the duration of the non-local worker's stay in the

Project area. It is also likely that some portion of construction materials would be purchased locally. Locally purchased concrete, miscellaneous consumable materials and fuel supply are estimated at $33.5 million. These direct payroll and materials expenditures would have a positive impact on local economies and would likely stimulate indirect expenditures within the region as inventories are restocked or new workers are hired to meet construction demands.

These direct payroll and materials expenditures would have a beneficial impact on the regional economy which would be multiplied through indirect expenditures as inventories are restocked or new employment opportunities are created. However, because construction-related investments are considered one-time expenditures, these beneficial impacts would be short-term. Once the funds leave the regional economy through savings, taxes, or purchases of goods and services from outside the region, the positive effects would no longer be multiplied. Therefore, construction of the facility would have a short-term beneficial impact on the regional economy.

Long-term impacts on a regional economy are generated primarily by increases or decreases in an employer's payroll and/or annual spending. The Project would create from 170 to 250 new permanent jobs, which would generate an increase in payroll spending over the 20-year operational life of the facility. This increase in spending would generate the same multiplied positive effects discussed above. Therefore, the Project also would have a long-term beneficial impact on the regional economy.

Upon completion of construction, the Project, as part of the larger SPLNG Terminal, would be subject to state and parish property taxes. There also would be short- and long-term increases in sales tax revenue from expenditures on construction materials and expenditures on goods and services by the construction and operational workforces.

Because no new land would be acquired for construction or operation of the Project and all construction activities would occur on land currently leased by Sabine Pass, no impact on property values is expected.

Public Services

The Project is not expected to increase the cost of public services such as public education, road maintenance and repair, and police and fire protection. Additionally, the Project is not expected to have an adverse impact on medical services. Most non-local construction personnel are not expected to relocate with dependents; therefore, impacts on local school districts are not expected to occur. During construction, enforcement activities associated with issuing permits for vehicle load and width limits could increase, and emergency medical services could be required to treat injuries resulting from construction accidents. These activities are not expected to generate the need for public agencies or local hospitals to hire new personnel, purchase new equipment, or construct new facilities. As noted in Section 2.5.1, the SPLNG Terminal has 24-hour on-site security, which would reduce demand on local police departments. The terminal also has an onsite firewater pond and pumps, which provide a water supply in the event of a fire. In the event public services are affected, any costs to Cameron Parish would be offset by the economic and fiscal benefits of the Project, including increased tax revenue, increased employment, and increased employment income.

The small increase in the regional population due to the relocation of new operational personnel and their families to the Project area would have a negligible impact on public services. The increase in population would represent less than 1 percent of the existing population in the Project area. The potential increase in population of from 445 to 655 persons is not expected to increase the cost of public services. Population increase in individual public service districts likely would be lessened because the new residents would reside in different localities throughout the Project area.

Construction of the Project would have short-term, minor adverse impacts on the transportation network (primarily SH 82) in the Project area. SH 82 and other existing public highways would be used to transport construction equipment and materials and workers to the SPLNG Terminal site. It is expected that most construction materials and workforce access to the SPLNG Terminal site would be from the west via SH 82, crossing the Sabine Pass Channel at the bridge on SH 82, with fewer trips accessing the site from the east via SH 27 and SH 82.

Construction work would be scheduled to take advantage of daylight hours, usually starting at 7:00 a.m. and finishing at 6:00 p.m., six days a week. Therefore, most construction personnel would commute to and from the SPLNG Terminal during off-peak traffic hours. In addition to construction personnel, heavy truck traffic would increase as construction materials and equipment are brought to the site. Sabine Pass estimates an average of 80 to 100 deliveries via truck per day during construction. Additional deliveries would be transported by barge to the construction dock on site, thus reducing the impact of material deliveries on local roads.

The small increase in the regional population due to the relocation of new operational personnel and their families to the Project area would have a negligible impact on public services. The increase in population would represent less than 1 percent of the existing population in the Project area. The potential increase in population of from 445 to 655 persons is not expected to increase the cost of public services. Population increase in individual public service districts likely would be lessened because the new residents would reside in different localities throughout the Project area.

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A Level of Service (LOS) and Pavement Surface Analysis was completed for SH 82 as part of the FEIS for construction of the SPLNG Terminal. LOS on a two-lane highway is defined by the percentage of time a typical vehicle would be required to follow a slower vehicle and cannot proceed at the desired or free-flow speed. There are six defined LOS designations, ranging from LOS A (a condition of free flow) to LOS F (forced flow at low speeds, where both speed and volume can drop to 0). Rural highways such as SH 82 typically operate at LOS B (stable flow with operating speeds beginning to be restricted somewhat by traffic conditions). The analysis indicated that SH 82 could accommodate 640 trips per day in and out of the SPLNG Terminal without a significant delay on SH 82, except potentially during peak worker commuting periods when a minor delay would be expected at the intersection of the site access road and SH 82. Based on the original analysis completed as part of the FEIS, the section of SH 82 immediately west of the Project site would operate at LOS D during a.m. and p.m. peak worker commuting periods, based on conservative assumptions of construction worker traffic. LOS D is a condition of decreasing free-flow levels when speeds slightly decrease and freedom to maneuver is limited; however, the roadway is not at capacity (i.e., with some congestion) at LOS D.

Because the Project would require between two and three times the number of employees during construction, the previous analysis is not adequate to represent impacts on traffic for the Project, but does provide for a baseline. A travel-time analysis was conducted for the construction period of the Project to identify and assess potential traffic impacts that may occur along SH 82. The methodology and assumptions used in this analysis are typical of those employed in federal transportation investigations designed to determine the value of travel time that is saved or lost due to the implementation of a large-scale project.

Valuations associated with time savings or losses (delays) used in this analysis are based upon research conducted by Thomas and Thompson, that is endorsed by the American Association of State Highway and Transportation Officials (Thomas and Thompson 1971), and the median household income for Jefferson County, Texas (US Census 2009). Level of service data for two-lane highways (designated speeds, times, and potential delays for alternative level of service ratings) was taken from the *Highway Capacity Manual* (TRB 2010). Annual average daily traffic (ADT) counts near the project site were based on ADT data from the Louisiana Department of Transportation (LDOTD) and anticipated escalated construction transits related to the terminal expansion.

In order to assess the full range of delay outcomes associated with this expansion our model assumes three graduating delay times of 10, 16, and 24 minutes. Estimated delay times are based on a changed LOS of the roadway during the recurrent peak morning and afternoon travel congestion times. We used a range of changed LOS starting with B to D based on the previous EIS analysis results as this would be the lowest impact. We also analyzed LOS changes from B to E and B to F to show the potential impacts up to the most conservative and severe traffic. Other assumptions included an average travel distance from Groves, Texas, to the project site of 20 miles, an average of 1.5 passengers per personal vehicle, an average of one person per work delivery truck, and a six-day work week

Utilizing this source data within appropriate mathematical procedures reveals the value of time lost from potential increases in traffic along SH-82 leading to the Sabine Pass terminal site. Table 2.5-10 displays the valuations for morning and afternoon commutes among all three alternative LOS delay scenarios evaluated within the analysis.

Table 2.5-10
Travel Time Loss Valuations (A.M and P.M Commutes)

Change in LOS	Annual Loss: A.M. and P.M. Commutes	Total Loss: A.M. and P.M. Commutes
LOS B to D	$1,015.400	$4,650,600
LOS B to E	$1,579,400	$7,233,600
LOS B to F	$2,369,200	$10,851,000

Based on this analysis the Project would result in short term impacts on traffic during the five year construction period. Traffic would return to pre-construction conditions once the Project begins operation.

Sabine Pass has identified the main construction parking area along the main plant road, near the southeastern part of the existing regasification facility. This area can accommodate approximately 1,720 parking spaces. An additional 9 acres of parking would be available west of Train 2, which would provide an additional 900 parking spaces, for a total of 2,620 available parking spaces on-site. Sabine Pass has also assumed that carpooling among the workforce would be highly likely and would occur at a rate of approximately 1.5 passengers per vehicle. Using this rate, the parking areas could accommodate approximately 3,930 workers, which would provide parking for all workers during peak construction times on-site.

Sabine Pass has identified the main construction parking area along the main plant road, near the southeastern part of the existing regasification facility. This area can accommodate approximately 1,720 parking spaces. An additional 9 acres of parking would be available west of Train 2, which would

provide an additional 900 parking spaces, for a total of 2,620 available parking spaces on-site. Sabine Pass has also assumed that carpooling among the workforce would be highly likely and would occur at a rate of approximately 1.5 passengers per vehicle. Using this rate, the parking areas could accommodate approximately 3,930 workers, which would provide parking for all workers during peak construction times on-site.

In addition to construction transportation, the Project would require yearly truck deliveries of propane, ethylene, and amine. Sabine Pass has estimated that each year approximately 78 trucks (8,800 gallons each) would deliver propane to its truck-loading stations, 57 trucks (8,800 gallons each) would deliver ethylene, and three trucks (5,500 gallons each) would deliver amine. The transportation of these liquids to the on-site truck-loading stations each year is not anticipated to significantly impact traffic on SH 82.

The Project is not expected to impact operations at the Port Arthur airport or the Sabine Pass heliport, since the Project would not be located in the approach path for any runways or for the heliport. The Project would include a marine and dry flare at a height of 377 feet (115 meters). The next tallest structure would be the compressor deck at 165 feet (50 meters). The Federal Aviation Administration requires notice under 14 Code of Federal Regulations 77.13 for structures more than 200 feet in height that are located at a horizontal distance of 20,000 feet from the nearest runway of an airport, excluding heliports. The Project is located over 80,000 feet east of the Port Arthur airport; therefore, the Project is not expected to impact existing airport operations.

2.5.3 Environmental Justice

Environmental justice considers disproportionately high and adverse impacts on minority or low-income populations in the surrounding community resulting from programs, policies, or activities of federal agencies. Issues considered include human health or environmental hazards, the natural or physical environment, and associated social, economic, and cultural factors. Environmental justice analysis is conducted in compliance with EO 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations."

All proposed facilities within both stages would be constructed and operated within the existing, leased 853-acre terminal site. No adverse environmental impacts outside the limits of the immediate Project site are anticipated. Construction and operation of the Project would not disproportionately affect any population group, including low-income and minority populations, and no environmental justice issues are expected as a result of construction or operation of the Project. The Project would have positive socioeconomic effects on the population in the Project area because it would generate new temporary and permanent jobs and economic activity, and provide continuing tax payments during its operational life.

2.6 Cultural Resources

Section 106 of the National Historic Preservation Act, as amended, requires the FERC to take into account the effects of its undertakings on properties listed or eligible for listing on the National Register of Historic Places and to afford the Advisory Council on Historic Preservation an opportunity to comment on the undertaking. Sabine Pass, as a non-federal party, is assisting us in meeting our obligations under Section 106 and the implementing regulations 36 CFR 800.

2.6.1 Cultural Resources Investigations

Sabine Pass has coordinated with the Louisiana Department of Culture, Recreation, and Tourism, Office of Cultural Development, Division of Archaeology (i.e., the State Historic Preservation Office [SHPO]) to determine whether the Project would require any additional surveys or consultations.

In 2004, Sabine Pass conducted cultural resource survey investigations at the SPLNG Terminal, including the temporary workspace areas, access roads, and associated aboveground facilities. The survey results indicated that no cultural resources would be affected by the Project. The results of these investigations were submitted to the FERC and the SHPO. The SHPO concurred with the results of the survey reports in a letter dated January 12, 2005, which was filed at the FERC on February 1, 2005, under Docket No. CP04-47. The SHPO was consulted again for additional work at the SPLNG Terminal in 2005 for any additional input regarding the previously approved site. The SHPO reconfirmed the "no effect" determination in correspondence dated July 6, 2005, which was filed at the FERC on July 29, 2005, under Docket No. CP05-396.

On June 17, 2010, Sabine Pass again contacted the SHPO to introduce the Sabine Pass Liquefaction Project. In a letter dated July 2, 2010, the SHPO stated that the 2004 survey was sufficient in its scope since it cleared the areas that would be used for the Project. The SHPO concluded that "no known historic properties would be affected by this undertaking" as proposed.

2.6.2 Native American Consultation

No Native American groups were consulted for the Project. For the original project at the SPLNG Terminal site, the six tribes listed below were consulted. Because these tribes expressed no objections during previous consultations, they were not contacted again for the current Project.

- Chitimacha Tribe of Louisiana
- Jena Band of Choctaw
- Caddo Nation
- Coushatta Tribe of Louisiana
- Alabama-Coushatta Tribe of Texas
- Tunica-Biloxi Tribe

2.6.3 Unanticipated Discoveries Plan

As part of construction of the SPLNG Terminal facilities, Sabine Pass implemented an Unanticipated Discoveries Plan to address measures that would be taken if cultural resources or human remains were inadvertently discovered during construction. The SHPO approved this plan in August 2004 and July 2005, and it was submitted to and approved by the FERC under the applicable dockets.

Sabine Pass provided an updated Unanticipated Discoveries Plan for the Liquefaction Project. We provided comments to the plan, and Sabine Pass provided a revised plan, which we approve.

2.6.4 Impacts and Mitigation

Stage 1 and Stage 2

Because construction and operation of both Stage 1 and Stage 2 of the Project would occur within the footprint of the existing SPLNG facility, and the SHPO has already concurred that construction activities within the existing facility area would have no effects on cultural resources, these portions of the Project would have no effect on cultural resources. As discussed in Section 2.6.3, however, the revised Unanticipated Discoveries Plan would be adhered to throughout construction activities.

Water Supply Pipeline

Because construction of the water supply pipeline would be done by HDD, cultural resources could potentially be affected in two areas: a 0.5-acre area for the HDD entry site; and a 2.2-acre area for the HDD exit site. The HDD exit site would be located within the footprint of the existing SPLNG facility and, therefore, did not require any additional cultural resources survey. The HDD entry site would be located outside the existing facility, within an area where a new water tower also is proposed to be constructed by the City of Port Arthur. A cultural resources survey was conducted for that area, and the report was provided to the SHPO and the FERC. No cultural resources were identified, and in a letter dated April 19, 2011, the SHPO concurred with the results of the report. We concur that the construction of the water supply pipeline would have no effect on cultural resources.

2.7 Air Quality and Noise

2.7.1 Air Quality

Air quality would be affected by construction and operation of the Project. Though air emissions would be generated by operation of equipment during construction of the aboveground facilities proposed by Sabine Pass, most air emissions associated with the Project would result from the long-term operation of the liquefaction facilities. We received several comment letters with concerns regarding the amount of emissions associated with liquefaction. This section of the EA addresses the construction and operating emissions from the Project, as well as projected impacts and compliance with regulatory requirements.

Existing Environment

The Project area is characterized by a modified marine climate that is influenced by the predominant onshore flow of tropical maritime air from the Gulf of Mexico during parts of the year. When onshore flow occurs, the region exhibits a more subtropical humid climate. During summer, sea breezes help moderate maximum temperatures.

According to National Climatic Data Center's Climatology of the United States No. 20 ([NCDC] 2010), which summarizes data for the years 1971 through 2000, temperatures at the Port Arthur Airport in Beaumont, Texas are generally highest in July and lowest in January. Monthly average daily maximum temperatures range from 61.5 degrees Fahrenheit (°F) in January to 91.6°F in July. Monthly average daily minimum temperatures range from 42.9°F in January to 73.8°F in July. Maximum temperatures of 90°F or higher occur about 82 days per year on average, while minimum temperatures of 32°F or lower occur about 13 days per year on average.

The mean annual precipitation at Port Arthur Airport is 59.9 inches. Monthly average precipitation ranges from a low of 3.35 inches in February to a maximum of 6.58 inches in June. Precipitation of 0.01 inch or greater occurs on about 106 days per year on average. Precipitation of 1.0 inch or greater occurs on average about 19 days per year. Thunderstorms occur in the area on about 60 days per year. The average annual snowfall is only 0.3 inch.

Based on a five-year period of record (1988 to 1992) for Port Arthur, Texas, the most frequent winds are from the south. Winds from southwest through north-northwest are relatively infrequent compared to other directions. The annual average wind speed during this five-year period was about 9.1 miles per hour. Wind direction shows significant seasonal variations. In the spring, winds from the south through southeast are most frequent. In the summer, winds from the south and west-southwest predominate. In the fall, winds from the north clockwise through south are common, while winds with any westerly component are infrequent. In the winter, winds from the north predominate.

Ambient air quality is protected by federal and state regulations. The Clean Air Act (CAA) and its amendments designate six pollutants as criteria pollutants for which the National Ambient Air Quality Standards (NAAQS) are promulgated. The NAAQS for sulfur dioxide (SO_2), nitrogen dioxide (NO_2), particulate matter (PM), including PM less than 10 microns in aerodynamic diameter (PM_{10}) and PM less than 2.5 microns in aerodynamic diameter ($PM_{2.5}$), carbon monoxide (CO), ozone (O_3), and lead were set to protect human health (primary standards) and public welfare (secondary standards). The current NAAQS for these criteria pollutants are summarized in Table 2.7-1.

Table 2.7-1
National Ambient Air Quality Standards

Pollutant	Averaging Period	NAAQS	
		Primary	Secondary
SO_2	Annual [a,l]	0.03 ppm 80 µg/m^3	--
	24-hour [b,l]	0.14 ppm 365 µg/m^3	--
	3-hour [b]	--	0.5 ppm 1300 µg/m^3
	1-hour [j,k]	75 ppb	
PM_{10}	24-hour [d]	150 µg/m^3	150 µg/m^3
$PM_{2.5}$	Annual [e]	15.0 µg/m^3	15.0 µg/m^3
	24-hour [f]	35 µg/m^3	35 µg/m^3
NO_2	Annual [a]	53 ppb 100 µg/m^3	53 ppb 100 µg/m^3
	1-hour [c]	100 ppb	53 ppb
CO	8-hour [b]	9 ppm 10,000 µg/m^3	-
	1-hour [b]	35 ppm 40,000 µg/m^3	-
Ozone (2008 Standard)	8-hour [g,h]	0.075 ppm	0.075 ppm
Ozone (1997 Standard)	8-hour [g,i]	0.080 ppm	0.080 ppm
Lead	Rolling 3-month [a]	0.15 µg/m^3	0.15 µg/m^3
	3-month [a]	1.5 µg/m^3	1.5 µg/m^3

Notes:
(a) Not to be exceeded.
(b) Not to be exceeded more than once per year.
(c) Compliance based on 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area.
(d) Not to be exceeded more than once per year on average over 3 years.
(e) Compliance based on 3-year average of weighted annual mean $PM_{2.5}$ concentrations at community-oriented monitors.
(f) Compliance based on 3-year average of 98th percentile of 24-hour concentrations at each population-oriented monitor within an area.
(g) Compliance based on 3-year average of fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area.
(h) The USEPA is currently reconsidering the 8-hour ozone standard set in March 2008.
(i) The 1997 8-hour ozone standard and associated implementation rules remain in place as the transition to the 2008 standard occurs.
(j) Compliance based on 3-year average of 99th percentile of daily maximum 1-hour average at each monitor within an area
(k) The 1-hour SO_2 standard is effective August 23, 2010.
(l) This standard will remain in effect until one year after the area is designated for the 2010 standard.

Key:
µg/m^3 = micrograms per cubic meter.
ppb = parts per billion by volume.
ppm = parts per million by volume.

Individual state air quality standards cannot be less stringent than the NAAQS. The LDEQ has adopted ambient air quality standards (LAAQS) that are the same as the NAAQS with the exceptions that the LDEQ has not yet adopted SO_2 or NO_2 1-hour standards or the 2008 ozone 8-hour standard, and the LAAQS use a calendar quarter averaging period for lead, with a primary and secondary standard equal to 1.5 μg/m^3. The LAAQS are promulgated in Title 33, Part III, Chapter 7, Section 711 of the LAC.

The USEPA and state and local agencies have established a network of ambient air quality monitoring stations to measure and track the background concentrations of criteria pollutants across the U.S. To characterize the background air quality in the region surrounding the Project, data were obtained from representative air quality monitoring stations. These monitoring stations are located near the proposed liquefaction facility site and provide information on regional ambient air quality conditions. For some criteria pollutants, ambient air quality monitoring data in the vicinity of the Project were not available. Therefore, the best available data were used to represent the air quality at those stations. A summary of the regional ambient air quality monitoring data from the three-year period (2006 to 2008) for the Project area is presented in Table 2.7-2.

Table 2.7-2
Ambient Air Quality Concentrations

Pollutant	Averaging Period	Rank	County, State	2008	2007	2006	Units	Monitor(s)
CO	1-hour	2nd high	Jefferson, TX	1.7	1.2	1.0	ppm	A
	8-hour	2nd high	Jefferson, TX	0.7	0.6	0.8	ppm	A
NO_2	annual	mean	Jefferson, TX	0.006	0.007	0.008	ppm	A
	1-hour	2nd high	Jefferson, TX	0.035	0.043	0.038	ppm	A
O_3	1-hour	2nd high	Jefferson, TX	0.088	0.080	0.080	ppm	B
	8-hour	4th high	Jefferson, TX	0.069	0.078	0.084	ppm	B
$PM_{2.5}$	24-hour	98th percentile	Jefferson, TX	32.6	26.7	26.7	μg/m^3	C
	annual	mean	Jefferson, TX	10.41	11.60	11.41	μg/m^3	C
PM_{10}	24-hour	2nd high	Galveston, TX	50	51	55	μg/m^3	D
	annual	mean	Galveston, TX	24	23	22	μg/m^3	D
SO_2	1-hour	2nd high	Jefferson, TX	0.137	0.096	0.136	ppm	E
	3-hour	2nd high	Jefferson, TX	0.053	0.064	0.073	ppm	E
	24-hour	2nd high	Jefferson, TX	0.017	0.023	0.032	ppm	E
	annual	mean	Jefferson, TX	0.003	0.003	0.003	ppm	E
Pb	Calendar quarter	maximum	Harris, TX	0.01	0.01	0.01	μg/m^3	F

Notes:

<u>Monitor Key</u>
A. Seattle Street, Nederland, Jefferson Co., TX (monitor no. 482451035).
B. 6019 Mechanic, Port Arthur, Jefferson Co., TX (monitor no. 482450101).
C 2200 Jefferson Drive, Port Arthur, Jefferson Co., TX (monitor no. 482450021)
D. 2516 Texas Avenue, Texas City, Galveston Co., TX (monitor no. 481670004).
E. 800 El Vista Road & 53rd Street, Port Arthur, Jefferson Co., TX (monitor no. 482450011).
F. 1262 ½ Mae Drive, Houston, Harris Co., TX (monitor no. 482011034)

ppm = parts per million
μg/m^3 = micrograms per cubic meter

On December 7, 2009, the USEPA defined air pollution to include six well-mixed greenhouse gases (GHGs), finding that the presence of these GHGs in at the atmosphere endangers public health and public welfare currently and in the future: CO_2, methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

As with any fossil-fuel fired project or activity, the Project would contribute GHG emissions. The principle GHGs that would be produced by the project are CH_4, CO_2, and N_2O. No fluorinated gases would be emitted by the Project. Emissions of GHGs are typically estimated as carbon dioxide equivalents (CO_2-eq).

GHGs are ranked by their global warming potential (GWP). The GWP is a ratio relative to CO_2 that is based on the properties of a GHG's ability to absorb solar radiation, as well as its residence time in the atmosphere. Thus, CO_2 has a GWP of 1, CH_4 has a GWP of 21, and N_2O has a GWP of 310. We received comments on the amount of GHG emissions the Project would contribute. In compliance with USEPA's definition of air pollution to include GHGs, we have provided estimates of GHG emissions for construction and operation, as discussed throughout this section. Impacts from GHG emissions (climate change) are discussed in more detail in section 2.9.

The Air Quality Control Regions (AQCRs) were established in accordance with Section 107 of the CAA as a means to implement the CAA and to comply with the NAAQS through State Implementation Plans. The AQCRs are intra- and interstate regions such as large metropolitan areas where the improvement of the air quality in one portion of the AQCR requires emission reductions throughout the AQCR. Each AQCR, or portion thereof, is designated as attainment, unclassifiable, maintenance, or nonattainment. Areas where an ambient air pollutant concentration is determined to be below the applicable ambient air quality standard are designated attainment. Areas where no data are available are designated unclassifiable. Unclassifiable areas are treated as attainment areas for the purpose of permitting a stationary source of pollution. Areas where the ambient air concentration is greater than the applicable ambient air quality standard are designated nonattainment. Areas that have been designated nonattainment but have since demonstrated compliance with the ambient air quality standard(s) are designated maintenance for that pollutant. The SPLNG Terminal is located in Cameron Parish, Louisiana, which is designated as in attainment for all regulated pollutants.

While Cameron Parish is in attainment for all criteria pollutants, three neighboring counties in Texas (Hardin, Jefferson, and Orange), comprising the Beaumont-Port Arthur Area, are classified as 8-hour ozone maintenance areas. These counties are within 50 miles of the Project location. Cameron Parish is also nearby to parishes in the Baton Rouge, Louisiana, Area that are designated nonattainment for 8-hour ozone and the Houston/Galveston/Brazoria 8-hour ozone severe nonattainment area.

Regulatory Requirements

The CAA, as amended in 1977 and 1990, is the basic federal statute governing air pollution. The provisions of the CAA that are potentially relevant to the Project include the following, which are discussed further below:

- Prevention of Significant Deterioration (PSD)/Nonattainment New Source Review (NNSR);
- Title V Operating Permits;
- New Source Performance Standards (NSPS);
- National Emission Standard for Hazardous Air Pollutants for Source Categories (NESHAP);
- Chemical Accident Prevention Provisions;
- General Conformity; and

- GHG Reporting Rule.

Prevention of Significant Deterioration/Nonattainment New Source Review

Separate procedures have been established for federal pre-construction air permit review of certain large proposed projects in attainment areas versus nonattainment areas. Federal preconstruction review for affected sources located in attainment areas is called PSD. This process is intended to keep new or modified major air emission sources from causing existing air quality to deteriorate beyond acceptable levels. Federal preconstruction review for affected sources located in nonattainment areas is commonly referred to as NNSR, which contains stricter thresholds and requirements. The SPLNG Terminal is located in an attainment area and is, therefore, potentially subject to PSD regulations.

The PSD regulations (40 CFR 52.21) define a major source as any source type belonging to a list of named source categories that emit or have the potential to emit 100 tons per year (tpy) or more of any regulated pollutant. A major source under PSD also can be defined as any source not on the list of named source categories with the potential to emit any regulated pollutant equal to or greater than 250 tpy. Modifications to existing facilities have lower pollutant thresholds, called Significant Emission Rates (100 tpy for CO; 40 tpy for NO_X, VOCs, and SO_2 [each]; 15 tpy for PM_{10}; and 10 tpy for $PM_{2.5}$), above which PSD review is triggered.

The SPLNG Terminal is an existing PSD major source, and the Project would be a major modification. Based on a comparison of the net emissions increase to the PSD de minimis levels, PSD review is required for PM_{10}, $PM_{2.5}$, NO_2, CO, and VOCs. Sabine Pass filed its revised air permit application with the LDEQ in March 2011. Facilities can trigger additional review by the USEPA if emissions exceed attainment area major source thresholds (the PSD major source thresholds) and if project-associated emissions exceed the PSD Significant Emission Rate for existing facilities defined as a PSD major source. The LDEQ approved Sabine Pass' revised air permit application on December 6, 2011, subject to the emissions limitations, monitoring requirements, and other conditions set forth in the permit.

On May 13, 2010, the USEPA issued the PSD GHG Tailoring Rule. This rule intends to account for facilities that represent an estimated 70 percent of GHG emissions from stationary sources while shielding smaller sources such as apartment buildings and schools. Beginning on January 2, 2011, a new industrial facility that is a major source for at least one non-GHG pollutant and which will emit or has the potential to emit at least 75,000 tpy of CO_2-eq would also be subject to GHG permitting requirements under PSD. Any existing industrial facility that is already considered a major source of a non-GHG pollutant and which will increase its GHG emissions by more than 75,000 tpy CO_2-eq would also be subject to GHG permitting requirements under PSD. Beginning on July 1, 2011, the new PSD major source threshold of 100,000 tpy of CO_2-eq became effective for new sources. For existing PSD major sources, the threshold for a modification would be 75,000 tpy CO_2-eq. The SPLNG Terminal is an existing PSD major source and has projected CO_2-eq emissions above 75,000 tpy. Therefore, the Project is subject to the PSD GHG Tailoring Rule, and Sabine Pass included a GHG Best Available Control Technology Analysis as part of its PSD permit modification.

One additional factor considered in the PSD review process is the potential impact on protected Class I areas. Areas of the country are categorized as Class I, Class II, or Class III. Class I areas are designated specifically as pristine natural areas or areas of natural significance and receive special protections under the CAA because of their good air quality. If a new source or major modification is subject to the PSD program requirements and is within 100 kilometers (62 miles) of a Class I area, the facility is required to notify the appropriate federal officials and assess the impacts of the proposed project on the Class I area. Class III designations, intended for heavily industrialized zones, can be made only on request, and must meet all requirements outlined in 40 CFR 51.166. The remainder of the United States is designated as Class II. The closest designated Class I area (Breton National Wildlife Refuge) is approximately 450 kilometers (279 miles) away. Because Breton National Wildlife Refuge is over 100 kilometers (62 miles) from the site, additional PSD Class I analysis was not required.

Title V Operating Permit

The Title V Operating Permit program, as described in 40 CFR Part 70, requires major stationary sources of air emissions to obtain an operating permit within one year of initial facility startup. The major source threshold levels for determining the need for a Title V Operating Permit are a potential to emit 100 tpy or more of any criteria pollutant, 10 tpy of any individual hazardous air pollutant (HAP), or 25 tpy of any combination of HAPs.

Also on May 13, 2010, the USEPA issued the Title V Tailoring Rule. Beginning on January 2, 2011, only newly constructed or existing Title V major sources would have Title V requirements for GHGs. Beginning on July 1, 2011, facilities that emit at least 100,000 tpy CO_2-eq would be subject to Title V permitting requirements.

The SPLNG Terminal is considered an existing Title V major source and currently operates under Title V permit number 0560-00214-V2. Sabine Pass applied to LDEQ to modify its existing Title V permit to include the facilities associated with the Project. The facility's modified Title V permit was issued by LDEQ on December 6, 2011, and included provisions allowing operation as both an export and import facility, with no restrictions on simultaneous operation of export and import equipment (i.e., bi-directional operation). Sabine Pass would also exceed the Title V Tailoring Rule Thresholds and were required to modify their Title V permit to meet GHG permitting requirements.

New Source Performance Standards

The NSPS, codified in 40 CFR Part 60, govern emission rates and provide other requirements for new or significantly modified sources. NSPS requirements include emission limits, monitoring, reporting, and record keeping. The following NSPS requirements were identified as potentially applicable to the Project.

NSPS Subpart Kb, Standards of Performance for Volatile Organic Liquid Storage Vessels, (Including Petroleum Liquid Storage Vessels) applies to storage vessels that are constructed, reconstructed, or modified after July 23, 1984, with a capacity greater than 75 cubic meters (19,800 gallons) that would store volatile organic liquids. Although the Project would include two propane refrigerant storage tanks sized at approximately 176,000 gallons each and three ethylene refrigerant storage tanks sized at approximately 71,000 gallons each, these tanks qualify as pressure vessels designed to operate in excess of 204.9 kilopascals and without emissions to the atmosphere. Therefore, these tanks are exempt from Subpart Kb.

NSPS Subpart JJJJ, Standards of Performance for Stationary Spark Ignition Internal Combustion Engines, applies to manufacturers and owner/operators of spark-ignition internal combustion engines manufactured after the applicability date stated in the rule for the particular type and size engine. The proposed natural gas-fired standby generators would be subject to NSPS Subpart JJJJ. The natural gas-fired engines must meet the applicable emission limits and operational requirements, as well as record-keeping and reporting requirements of this subpart.

NSPS Subpart KKKK, Standards of Performance for Stationary Combustion Turbines, applies to manufacturers and owner/operators of gas turbines manufactured after the applicability date stated in the rule for the particular type and size gas turbine. Subpart KKKK regulates emissions of NO_X and SO_2. The proposed gas turbines to drive refrigeration compressors and electrical generators would be subject to NSPS Subpart KKKK. The turbines must meet the applicable emission limits and operational requirements, as well as record-keeping and reporting requirements of this subpart.

National Emission Standards for Hazardous Air Pollutants

The NESHAPs, codified in 40 CFR Parts 61 and 63, regulate the emissions of HAPs from existing and new sources. Part 61 was promulgated prior to the 1990 CAA Amendments and regulated eight types of hazardous substances: asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionuclides, and vinyl chloride. The proposed compressor stations are not expected to operate any processes that are regulated by Part 61.

The 1990 CAA Amendments established a list of 189 HAPs, resulting in the promulgation of Part 63. Part 63, also known as the Maximum Achievable Control Technology (MACT) standards, regulates HAP emissions from major sources of HAP emissions and specific source categories that emit HAPs. Some NESHAPs may apply to non-major sources (area sources) of HAPs. The major source thresholds for the purpose of NESHAP applicability are 10 tpy of any single HAP or 25 tpy of all HAPs in aggregate. The existing facilities at the SPLNG Terminal were not considered major with respect to HAP emissions. However, the combined Project and existing SPLNG Terminal emissions would exceed the major source threshold for HAP emissions.

NESHAP for marine tank vessel-loading operations were promulgated under Subpart Y and applies to marine vessel loading operations at facilities that are considered major sources of HAPs. Although the Project would be considered a major source of HAPs, this subpart does not apply to emissions resulting from marine tank vessel-loading operations of commodities with vapor pressures less than 10.3 kilopascals at standard conditions. Therefore, this subpart does not apply to the Project.

NESHAP for stationary combustion turbines were promulgated under Subpart YYYY. Under Subpart YYYY, there are no requirements applicable to existing turbines greater than or equal to 1 MW (approximately 1,340 hp). Furthermore, on August 18, 2004, the D.C. Circuit Court issued a Stay of Implementation on 40 CFR Part 63, Subpart YYYY. The USEPA is evaluating the possibility of delisting gas-fired turbines from the Rule. Currently, natural gas-fired turbines are only subject to the general permitting and notification requirements under 40 CFR Part 63, Subpart A. Thus, there are no pollutants regulated under the current Subpart YYYY. The natural gas-fired refrigeration compressor and generator turbines qualify as new stationary combustion turbines under Subpart YYYY and would be subject to the initial notification requirements.

NESHAP for reciprocating internal combustion engines (RICE) were promulgated under Subpart ZZZZ. Under Subpart ZZZZ, new engines located at an area source of HAPs that are subject to NSPS Subpart JJJJ have no additional requirements under Subpart ZZZZ. The two proposed natural gas-fired emergency generators would be subject to NSPS Subpart JJJJ and would have no additional requirements under Subpart ZZZZ. In addition, pursuant to additional sections to subpart ZZZZ promulgated on March 3, 2010, the existing diesel firewater booster pumps 1 and 2 became subject to Subpart ZZZZ. Also, the existing diesel firewater pumps 1, 2, and 3 and standby diesel generators 1 and 2 qualify as new stationary RICE under Subpart ZZZZ. However, these facilities qualify as emergency RICE under this subpart and are only subject to the initial notification requirements.

Chemical Accident Prevention Provisions

The chemical accident prevention provisions, codified in 40 CFR 68, are federal regulations designed to prevent the release of hazardous materials in the event of an accident and minimize potential impacts if a release does occur. The regulations contain a list of substances and threshold quantities for determining applicability to stationary sources, including methane, propane, and ethylene in amounts greater than 10,000 pounds. If a stationary source stores, handles, or processes one or more substances on this list in a quantity equal to or greater than that specified in the regulation, the facility must prepare and submit a risk management plan (RMP). An RMP is not required to be submitted to the USEPA until the chemicals are stored on-site at the facility.

If a facility does not have a listed substance on-site, or the quantity of a listed substance is below the applicability threshold, the facility does not have to prepare an RMP. In the latter case, the facility still must comply with the requirements of the general duty provisions in Section 112(r)(1) of the 1990 CAA Amendments if there is any regulated substance or other extremely hazardous substance on-site. The general duty provision is as follows:

"The owners and operators of stationary sources producing, processing, handling and storing such substances have a general duty to identify hazards which may result from such releases using appropriate hazard assessment techniques, to design and maintain a safe facility, taking such steps as are necessary to prevent releases, and to minimize the consequences of accidental releases which do occur."

Stationary sources are defined in 40 CFR 68 as any buildings, structures, equipment, installations, or substance-emitting stationary activities that belong to the same industrial group, that are located on one or more contiguous properties, are under control of the same person (or persons under common control), and are from which an accidental release may occur. The Project would use methane, propane, and ethylene as refrigerants in the overall process for liquefying the natural gas: Propane would be stored on-site in quantities approximating 1,709,655 pounds; ethylene would be stored on-site in quantities approximating 1,034,535 pounds; and methane would be used in the liquefaction process in quantities greater than 10,000 pounds.

The definition of a stationary source does not apply to transportation of any regulated substance or any other extremely hazardous substance. When the USEPA issued the final rule for chemical accident prevention provisions (FR, January 6, 1998 (Volume 63, Page 639-645), it clarified that the transportation exemption applies to LNG facilities subject to oversight or regulation under 49 CFR Part 193. These exempt facilities include those used to liquefy natural gas or those used to transfer, store, or vaporize LNG in conjunction with pipeline transportation. We have included an analysis of the proposed design's compliance with Part 193, including overpressure modeling, in Section 2.8.5 of this EA.

General Conformity

The USEPA promulgated the General Conformity Rule on November 30, 1993, to implement the conformity provision of Title I, Section 176(c)(1) of the CAA. On March 24, 2010, the USEPA amended the General Conformity Rule. Section 176(c)(1) requires that the federal government not engage, support, or provide financial assistance for licensing or permitting, or approve any activity not conforming to, an approved CAA implementation plan.

The General Conformity Rule is codified in Title 40 CFR Part 51, Subpart W and Part 93, Subpart B, Determining Conformity of General Federal Actions to State or Federal Implementation Plans. A conformity determination must be conducted by the lead federal agency if a federal action's construction and operational activities is likely to result in generating direct and indirect emissions that would exceed the conformity threshold levels (de minimis) of the pollutant(s) for which an air basin is in nonattainment or maintenance. According to the conformity regulations, emissions from sources that are major for any criteria pollutant with respect to the NNSR or PSD permitting/licensing are exempt and are deemed to have conformed.

Section 176(c)(1) of the CAA (Title 40 CFR 51.853), states that a federal agency cannot approve or support any activity that does not conform to an approved state implementation plan. Conforming activities or actions should not, through additional air pollutant emissions:

- Cause or contribute to new violations of the NAAQS in any area;
- Increase the frequency or severity of any existing violation of any NAAQS; or,
- Delay timely attainment of any NAAQS or interim emission reductions.

As noted earlier, the Project operating site would be located in an attainment area; however, the three neighboring counties in Texas (Hardin, Jefferson, and Orange), are located in the Beaumont-Port Arthur Area 8-hour ozone maintenance area. Also, some barge transport would originate at the Port of Houston, which is located in the Houston-Galveston-Brazoria, Texas, 8-hour Ozone Severe non-attainment area. Operating emissions would be located entirely within the attainment area and would be subject to PSD permitting and, therefore, are not subject to General Conformity Regulations. Construction emissions, including barge transport, would be subject to General Conformity Regulations for any emissions that occur in the Beaumont-Port Arthur ozone maintenance area or the Houston-Galveston-Brazoria non-attainment area. Sabine Pass indicated some barges would most likely originate at the Port of Houston and travel 97 nautical miles (84 miles) along the Intracoastal Waterway to Port Arthur, Texas, and the SPLNG Terminal construction dock.

Sabine Pass provided a description of the operation of the barge/tug vessels to be used to transport construction materials through the Gulf Intracoastal Waterway (GIWW). These vessels would operate in and near the Port of Houston, which would impact the Houston-Galveston-Brazoria ozone nonattainment area. The adjacent counties along the GIWW (Jefferson and Orange counties) to Port Arthur, Texas, are in the Beaumont-Port Arthur maintenance area, which was previously designated a moderate nonattainment area for the 8-hour ozone standard. Vessels would impact the Beaumont-Port Arthur area when they travel through Jefferson and Orange Counties on the way to and from the Port of Houston and, to a much lesser extent, when they enter Texas waters between ports in Louisiana to the SPLNG Terminal construction dock. Vessels traveling along the GIWW in Louisiana would remain outside the Baton Rouge nonattainment area (i.e., the parishes of Ascension, East Baton Rouge, Iberville, Livingston, and West Baton Rouge) and impact only unclassifiable or attainment areas in Louisiana.

Sabine Pass estimated emissions from the tug vessels that push the barges using the methods described in *Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories* (ICF International, April 2009). Sabine Pass also estimated travel distances between ports using NOAA's *Distances Between United States Ports, 2009* (10^{th} Edition). The emissions were apportioned among the severe nonattainment, serious nonattainment, and unclassifiable or attainment areas according to the emission rate (pounds per hour) calculated to occur during the time spent traveling through each of these areas.

Sabine Pass did not estimate projected percentages of workers commuting from the maintenance area from their total worker commuting on-road emission estimates. Therefore, to conservatively determine General Conformity Applicability, we have assumed all worker commuting emissions would occur within the maintenance area. The total emissions within the nonattainment and maintenance areas were compared to those emissions with the General Conformity Applicability thresholds for ozone as shown in Table 2.7-3.

Table 2.7-3
Summary of General Conformity Applicable Emissions
(in tons per year)

Year	Construction Emission Source	Beaumont-Port Arthur Area			Houston-Galveston-Brazoria Area		
		(NO_X)	(VOCs)	(SO_2)	(NO_X)	(VOCs)	(SO_2)
2012	On-road	1	1	<0.1	-	-	-
	Barges	7	0.2	5	0.2	<0.1	0.1
	Sub-total	**8**	**1.2**	**5**	**0.2**	<0.1	**0.1**

Continued Table 2.7-3 Summary of General Conformity Applicable Emissions (in tons per year)							
		Beaumont-Port Arthur Area			Houston-Galveston-Brazoria Area		
Year	Construction Emission Source	(NO_X)	(VOCs)	(SO_2)	(NO_X)	(VOCs)	(SO_2)
2013	On-road	9	4	<0.1	-	-	-
	Barges	11	0.4	9	1	<0.1	1
	Sub-total	**20**	**4.4**	**9**	**1**	<0.1	**1**
2014	On-road	12	8	0.1	-	-	-
	Barges	2	0.1	1	1	<0.1	1
	Sub-total	**14**	**8.1**	**1**	**1**	<0.1	**1**
2015	On-road	12	6	0.1	-	-	-
	Barges	-	-	-	-	-	-
	Sub-total	**12**	**6**	**0.1**	**0**	**0**	**0**
2016	On-road	7	4	0.1	-	-	-
	Barges	-	-	-	-	-	-
	Sub-total	**7**	**4**	**0.1**	**0**	**0**	**0**
2017	On-road	1	1	<0.1	-	-	-
	Barges	-	-	-	-	-	-
	Sub-total	**1**	**1**	**<0.1**	**0**	**0**	**0**
General Conformity Threshold		**100**	**100**	**100**	**25**	**25**	**N/A**
Note: On-road emissions = Worker commuting vehicle emissions.							

The maximum annual emission rates for NO_X and VOCs due to construction in the Houston-Galveston-Brazoria Area are 1 tpy and <0.1 tpy, respectively. These are below the de minimus emission rate for NO_X and VOCs of 25 tpy for severe ozone nonattainment areas. Similarly, the maximum annual emission rates for NO_X and VOCs due to construction in the Beaumont-Port Arthur Area are 20 tpy (in year 2013) and 8 tpy (in year 2014), respectively. These are also below the de minimus emission rate for NO_X and VOCs of 100 tpy for moderate ozone maintenance areas. The Project would be below the General Conformity Applicability threshold and a General Conformity Determination is not required for the Project.

<u>Greenhouse Gas Reporting Rule</u>

On September 22, 2009, the EPA issued the final Mandatory Reporting of Greenhouse Gases Rule. This rule requires reporting of GHG emissions from suppliers of fossil fuels and facilities that emit greater than or equal to 25,000 metric tpy of GHG (reported as CO_2-eq). On November 8, 2010, the EPA signed a rule that finalizes GHG reporting requirements for the petroleum and natural gas industry under Subpart W of 40 CFR Part 98. The industry segments LNG storage, and LNG import and export equipment as considered part of the source category regulated by Subpart W. The rule does not apply to construction emissions.

GHG emissions from the existing SPLNG Terminal and Project are shown in Table 2.7-6 and 2.6-8. Combined emissions are projected to be above the 25,000 tpy CO_2-eq threshold. The SPLNG

Terminal and Liquefaction facilities would potentially be subject to the GHG Mandatory Reporting Rule. The rule does not require emission control devices and is strictly a reporting requirement based on actual emissions. Sabine Pass would monitor emissions in accordance with the reporting rule and, if actual emissions exceed the 25,000 tpy CO_2-eq reporting threshold, Sabine Pass would be required to report its GHG emissions to the EPA.

State Regulations

The LDEQ is the lead air permitting authority for the SPLNG Terminal. The LDEQ's air permitting requirements are codified in LAC, Title 33, Part III. The Project would be required to obtain an air quality permit prior to initiating construction. Facilities also trigger review by other states if the project location is within 50 miles of an adjacent state's border. The SPLNG Terminal is located within 1 mile of the Texas state line; therefore, the TCEQ will have the opportunity to review and comment on the application and subsequent permits.

Louisiana air toxics regulations are codified in LAC 33:III.Chapter 51. These are state-only requirements because they are not part of the Louisiana State Implementation Plan and are, therefore, not federally enforceable. The Chapter 51 regulations require application of MACT for Class I and Class II toxic air pollutants (TAPs) exceeding their corresponding Minimum Emission Rate.

In addition to the specific requirements, there are general requirements for sources subject to NSPS, NESHAP, and MACT standards. All sources subject to the NSPS, NESHAP, and MACT standards are subject to the applicable provisions of the relevant Subpart A. Based on the proposed modifications, Sabine Pass anticipates the SPLNG Terminal would be a major source of TAPs and, therefore, would need to comply with the applicable requirements specified under the Louisiana Air Toxics Program (LAC 33:III.Chapter 51), as required.

Impacts and Mitigation

The Project would produce air pollutant emissions during the construction phase and operational phase. Although construction activities are typically considered temporary, construction of the liquefaction terminal would occur over a five-year period in one location; therefore, the impacts are considered short-term. In addition, following construction, air quality would not revert back to previous conditions but would transition to operational-phase emissions after commissioning and initial startup of the facility.

Construction Emissions

Construction of the Project would result in short-term increases in emissions of some pollutants due to the use of equipment powered by diesel fuel or gasoline engines and the generation of fugitive dust due to disturbance of the surface and other dust-generating actions. There also may be some temporary indirect emissions attributable to construction workers commuting to and from work sites during construction and from barges transporting construction materials.

The quantity of fugitive dust generated by construction-related activities depends on several factors, including the size of area disturbed, the nature and intensity of construction activity, surface properties (such as the silt and moisture content of the soil), the wind speed, and the speed, weight, and volume of vehicular traffic. Fugitive dust emissions would be limited or mitigated, if necessary, by spraying water to dampen the surfaces of dry work areas and/or by the application of calcium chloride or other dust suppressants as needed. Table 2.7-4 provides estimates of fugitive dust emissions associated with construction activities for the duration of the entire Project and assumes a dust suppressant control efficiency of 50%.

Table 2.7-4 Fugitive Dust Emissions from Construction				
Activity	**Land Affected (acres)**	**Duration (months)**	**PM_{10} (tpy)**	**$PM_{2.5}$ (tpy)**
Newly Impacted Land	191.2	62	492	74
Previously Impacted Land	64.77	62	167	25
		Total	**658**	**99**
Notes: Emission factor used is most applicable to a semi-arid climate; therefore, calculated emissions should exceed those for the actual site.				

Emissions of NO_X, CO, PM_{10}/$PM_{2.5}$, SO_2, VOCs, and GHGs from construction vehicle engines were estimated for the Project construction activities. The estimates are based on the construction equipment that is expected to be used (number, type, capacity, and level of activity). Emissions attributable to vehicles driven by construction workers commuting to and from the Project work site during construction also were estimated. Sabine Pass also estimated that three to four barges per week would be required for pile delivery for a 10-month period beginning in September 2012 and continuing through June 2013. Following pile delivery, approximately two barges per month would be required to provide other material and equipment for another 10 months, ending in March 2014. Therefore, emissions from barge activity are included in the emissions estimate of criteria pollutants. Emissions from construction of the water supply pipeline would occur for a three- to four-day period from use of HDD equipment. Due to the short duration of construction and limited use of equipment, these emissions would be minor and are not included in the construction emission summary.

Summaries of construction criteria pollutant emissions and GHG emissions from all sources by year are shown in Tables 2.7-5 and 2.7-6, respectively. NO_X and/or CO emissions due to construction would be above 100 tpy (as shown in Table 2.7-5) for at least the first five years of the construction period. Construction equipment would be operated primarily on an as-needed basis during daylight hours. The emissions from gasoline and diesel engines would be minimized because the engines must be built to meet the standards for mobile sources established by the USEPA mobile source emission regulations. Most of the construction equipment would be powered by diesel engines and would be equipped with typical control equipment (e.g., catalytic converters).

Table 2.7-5 Summary of Construction Emissions of Criteria Pollutants (in tons per year)						
Year	**Construction Emission Source**	**Nitrogen Oxide (NO_X)**	**Volatile Organic Compounds (VOCs)**	**Carbon Dioxide (CO)**	**Sulfur Dioxide (SO_2)**	**Particulate Matter (PM_{10}/ $PM_{2.5}$)**
2012	Non-road	109	11	60	1	8
	On-road	1	1	21	<0.1	<0.1
	Barges	17	1	1	27	2
	Sub-total	**127**	**13**	**82**	**28**	**10**

Continued Table 2.7-5 Summary of Construction Emissions of Criteria Pollutants (in tons per year)						
Year	**Construction Emission Source**	**Nitrogen Oxide (NO_X)**	**Volatile Organic Compounds (VOCs)**	**Carbon Dioxide (CO)**	**Sulfur Dioxide (SO_2)**	**Particulate Matter (PM_{10}/ $PM_{2.5}$)**
2013	Non-road	154	15	98	2	12
	On-road	9	4	64	<0.1	<0.1
	Barges	29	1	2	22	3
	Sub-total	**192**	**20**	**164**	**24**	**15**
2014	Non-road	94	11	65	2	7
	On-road	12	8	89	0.1	<0.1
	Barges	7	<1	<1	5	<1
	Sub-total	**113**	**19**	**154**	**7**	**8**
2015	Non-road	53	7	41	1	4
	On-road	12	6	101	0.1	0.1
	Barges	-	-	-	-	-
	Sub-total	**65**	**13**	**142**	**1**	**4**
2016	Non-road	38	6	41	<1	3
	On-road	7	4	59	0.1	0.1
	Barges	-	-	-	-	-
	Sub-total	**45**	**10**	**100**	**<1**	**3**
2017	Non-road	4	1	4	<1	<1
	On-road	1	1	9	<0.1	<0.1
	Barges	-	-	-	-	-
	Sub-total	**5**	**2**	**13**	**<1**	**<1**

Note:
Non-road emissions = Construction equipment and vehicle emissions related to site activity.
On-road emissions = Worker commuting vehicle emissions.

Table 2.7-6 Construction Emissions of Greenhouse Gases (in tons per year)					
Year	**Construction Emission Source**	**Carbon Dioxide (CO_2)**	**Nitrous Oxide (N_2O)**	**Methane (CH_4)**	**Carbon Dioxide Equivalent (CO_2-eq)**
2012	Non-Road	16,518	0.42	0.94	16,669
	On-road	1,386	0.06	0.08	1,406
	Sub-total	**17,904**	**0.48**	**1.02**	**18,075**

Continued Table 2.7-6 Construction Emissions of Greenhouse Gases (in tons per year)					
Year	**Construction Emission Source**	**Carbon Dioxide (CO_2)**	**Nitrous Oxide (N_2O)**	**Methane (CH_4)**	**Carbon Dioxide Equivalent (CO_2-eq)**
2013	Non-road	24,656	0.63	1.4	24,881
	On-road	4,336	0.17	0.24	4,393
	Sub-total	**28,992**	**0.80**	**1.64**	**29,274**
2014	Non-road	17,262	0.44	0.98	17,419
	On-road	6,150	0.23	0.33	6,228
	Sub-total	**23,412**	**0.67**	**1.31**	**23,647**
2015	Non-road	11,373	0.29	0.65	11,477
	On-road	7,173	0.25	0.39	7,260
	Sub-total	**18,546**	**0.54**	**1.04**	**18,737**
2016	Non-road	10,253	0.26	0.58	10,346
	On-road	4,373	0.14	0.00	4,418
	Sub-total	**14,626**	**0.40**	**0.58**	**14,764**
2017	Non-road	1,298	0.03	0.07	1,309
	On-road	675	0.02	0.00	681
	Sub-total	**1,973**	**0.05**	**0.07**	**1,990**
Notes: Non-road emissions = Construction equipment and vehicle emissions related to site activity. On-road emissions = Worker commuting vehicle emissions.					

Fugitive dust emissions of total suspended particulates (TSP) and PM10 would be well above 100 tpy, even with an assumed fugitive dust control factor of 50% through use of dust suppression techniques. Although Sabine Pass identified a mitigation measure to reduce fugitive dust formation (spraying water on work areas and/or the application of calcium chloride or other dust suppressants), we do not believe these measures are sufficient to ensure adequate mitigation of fugitive dust emissions that would occur in the same area over a multi-year period. In addition, Sabine Pass has not provided any information about accountability or individuals with authority regarding fugitive dust mitigation. Therefore, **we recommend that:**

- **Prior to construction, Sabine Pass should file a Fugitive Dust Control Plan with the Secretary of the Commission (Secretary), for review and written approval of the Director of OEP. The plan should specify the following:**

  a. **the precautions that Sabine Pass would take to minimize fugitive dust emissions from construction activities, including additional mitigation measures to control fugitive dust emissions of TSP and PM10;**

  b. **the individuals with the authority to determine if/when water needs to be reapplied for dust control;**

  c. **the individuals with the authority to determine if/when a palliative needs to be used;**

d. **the individuals with the authority to stop work if the contractor does not comply with dust control measures; and**

e. **additional dust control measures, including:**

   (1) **measures to limit track-out onto the roads;**

   (2) **the speed limit that Sabine Pass would enforce on unsurfaced roads; and**

   (3) **covering open-bodied haul trucks, as appropriate.**

Construction of the Project would occur over a five-year period, resulting in short-term impacts on air quality. Conditions after completion of construction would transition to operational-phase emissions after commissioning and initial startup of the facility.

Operational Emissions

The Project includes the following stationary point sources of air pollutants:

- Four acid gas vents;
- One marine flare;
- Two wet gas flares;
- Two dry gas flares;
- Twenty-four gas-fired refrigeration compressor turbines;
- Two gas-fired power generation turbines;
- Two gas-fired standby generators; and
- Fugitive emission sources (valves, flanges, connectors, and pump seals).

The Project and existing SPLNG Terminal potential annual emissions for criteria pollutants and HAPs are shown in Table 2.7-7, and potential annual GHG emissions are shown in Table 2.7-8. The emission data are based on USEPA emission factors obtained from AP-42, applicable federal and/or state regulatory emission limitations, and manufacturer-supplied emission factors, where available. Potential to emit is based on continuous operation (8,760 hours per year) except for standby engines, for which potential to emit is based on 500 hours per year of operation.

As part of the air permit application process, Sabine Pass prepared a Best Available Control Technology Analysis (BACT) for the refrigeration compressor turbines, power generation turbines, and internal combustion engines (standby generators). Methods for reducing emissions of NO_X, CO, and VOCs for each of these emission sources were evaluated based on technical feasibility. Through this process and review by LDEQ, Sabine Pass would reduce emissions of NO_X for the refrigeration compressor and power generation turbines through use of water-injection; CO and VOC emission rates would be maintained through use of good combustion practices. The standby generators would utilize natural gas instead of diesel fuel, resulting in a slight reduction in emissions.

Table 2.7-7
Potential to Emit for Criteria and Hazardous Air Pollutants
(in tons per year)

Emission Unit	NO_X	VOCs	CO	PM_{10}	$PM_{2.5}$	SO_2	Total HAP	Individual HAP [(a)]
Liquefaction Project								
Acid gas vents (4)	-	-	-	-	-	-	35	24
Flares – Marine (1), Wet gas (2), Dry gas (2)	3	0.16	10	0.21	0.21	0.05		
Refrigeration compressor turbines (24)	2,412	63	4,583	199	199	-		
Natural gas-fired generator turbines (2)	251	5.	153	17	17	-		
Standby natural gas-fired engines (2)	4	2.22	9	0.34	0.34	0.02		
Fugitive emissions	-	17	-	-	-	-		
Sub-total	**2,670**	**88**	**4,759**	**216**	**216**	**0.07**	**35**	**24**
Existing SPLNG Terminal								
Submerged combustion vaporizers (24)	420	34	749	16	16	3	7	4
Standby generator diesel engines (2)	17	2	21	1	1	0.40		
Firewater pump diesel engines (3)	9	0.06	0.42	0.93	0.90	0.18		
Firewater booster pump diesel engines (2)	2	0.06	0.10	0.04	0.04	0.06		
Natural gas-fired generator turbines (4)	475	19	286	34	34	1		
Fuel dispensing facility	-	1	-	-	-	-		
Fugitive emissions	-	2.18	-	-	-	-		
Sub-total	**923**	**59**	**1,057**	**52**	**52**	**5**	**7**	**4**
Total Facility	**3,246**	**126**	**5,334**	**268**	**268**	**5**	**40**	**26**

Notes:
(a) Worst-case individual HAP emissions from the Project are presented for formaldehyde.
Total facility emissions are based on data presented in the Title V and PSD permits.
Emission factors for acid gas vent emissions are based on engineering design simulations.

Table 2.7-8 Potential to Emit for Greenhouse Gases (in tons per year)				
Emission Unit	**CO_2**	**N_2O**	**CH_4**	**CO_2-eq**
Liquefaction Project				
Acid gas vents (4)	6.55E02	-	1.57E00	6.88E02
Flares – Marine (1), Wet gas (2), Dry gas (2)	3.06E03	5.18E-03	1.78E01	3.44E03
Refrigeration compressor turbines (24)	3.52E06	6.64E00	6.64E01	3.52E06
Natural gas-fired generator turbines (2)	2.93E05	5.53E-01	5.53E00	2.93E05
Standby natural gas-fired generator (2)	8.23E02	1.55E-03	1.55E-02	8.24E02
Fugitive emissions	5.78E01	-	4.27E03	8.96E04
Sub-total	**3.82E06**	**7.2E00**	**4.36E03**	**3.91E06**
Existing SPLNG Terminal				
Submerged combustion vaporizers (24)	1.33E06	2.50E00	2.50E01	1.33E06
Standby generator diesel engines (2)	1.27E03	1.03E-02	5.50E-02	1.27E03
Firewater pump diesel engines (3)	5.64E02	4.59E-03	2.29E-02	5.67E02
Firewater booster pump diesel engines (2)	1.71E02	1.39E-03	6.94E-03	1.72E02
Natural gas-fired generator turbines (4)	5.92E05	1.12E00	1.12E01	5.96E05
Fuel dispensing facility	-	-	-	-
Fugitive emissions	1.25E01	-	9.20E02	1.93E04
Sub-total	**1.92E06**	**3.64E00**	**9.56E02**	**1.94E06**
Total Facility	**4.87E06**	**9.20E00**	**5.30E03**	**4.99E06**

Due to the operational flexibility of the SPLNG facility after construction of the Project, Sabine Pass could operate under multiple scenarios. Although Sabine Pass would have the capability to operate liquefaction and regasification simultaneously (the annual emission scenario identified above), market forces would likely determine the utilization of either liquefaction or regasification facilities. Higher worldwide prices (compared to the U.S.) would likely cause Sabine Pass customers to liquefy U.S.-sourced natural gas and export it abroad. Alternatively, higher prices in the U.S. (compared to worldwide markets) would likely cause Sabine Pass customers to deliver LNG to the SPLNG Terminal and utilize the regasification capability. If U.S. and worldwide prices are similar, Sabine Pass customers likely would opt to not use either regasification or liquefaction capability. The regasification facilities were previously evaluated and authorized through NEPA and LDEQ permitting. Short-term emission rates for the liquefaction project are being treated as a separate operating scenario for the SPLNG Terminal. Maximum short-term controlled emission rates are listed in Table 2.7-9. The short-term emission rates shown for each scenario are not anticipated to occur simultaneously.

Table 2.7-9
Maximum Short-Term Controlled Emissions for Criteria Pollutants
(in pounds per hour)

Emission Unit	NO_X	VOCs	CO	PM_{10}	$PM_{2.5}$	SO_2
Liquefaction Project						
Acid gas vents (4)	-	-	-	-	-	-
Flares – Marine (1), Wet gas (2), Dry gas (2)	168.44	9.85	641.75	13.61	13.61	1.07
Refrigeration compressor turbines (24)	688.32	14.40	419.04	45.36	45.36	-
Natural gas-fired generator turbines (2)	57.36	1.20	34.92	3.78	3.78	-
Standby natural gas-fired engines (2)	42.34	2.58	22.14	1.32	1.28	0.04
Fugitive emissions	-	5.03	-	-	-	-
Sub-total	**956.46**	**33.06**	**1,117.85**	**64.07**	**64.03**	**1.11**
Existing SPLNG Terminal						
Submerged combustion vaporizers (24)	108	7.68	227.28	3.6	3.6	0.72
Standby generator diesel engines (2)	67.54	9.78	83.2	3.92	3.8	1.56
Firewater pump diesel engines (3)	36.57	0.21	1.65	3.72	3.6	0.72
Firewater booster pump diesel engines (2)	6.88	0.20	0.36	0.12	0.12	0.20
Natural gas-fired generator turbines (4)	116	4.8	71.2	8.44	8.44	0.36
Fuel dispensing facility	-	4.06	-	-	-	-
Fugitive emissions	-	0.5	-	-	-	-
Sub-total	**334.99**	**27.23**	**383.69**	**19.80**	**19.56**	**3.56**
Total Facility	**1,291.45**	**60.29**	**1,501.54**	**83.87**	**83.59**	**4.67**

Once constructed, the facility would undergo an initial startup process before it could be fully operational. Initial facility startup would consist of a series of steps primarily aimed at conditioning, drying out, and cooling the various components of the liquefaction process equipment. Facility startup would begin with the activation of electrical generators, flares, and other support equipment. Cleaning of various components would then occur, followed by drying out of the system and cooling of the liquefaction system. These steps would result in larger emissions than under normal operating conditions and would last approximately 1 to 2 months. After initial startup, Sabine Pass plans to continuously operate the liquefaction facility, thus limiting startup/shutdown events to those associated with individual components as part of maintenance or the need to shut down due to equipment malfunction. Table 2.7-10 summarizes the criteria pollutants and HAP emissions, and Table 2.7-11 summarizes the GHG emissions for initial startup activities.

Table 2.7-10
Liquefied Natural Gas (LNG) Train Startup Emissions - Criteria Pollutants

Pollutant	Emissions (tons)
Particulate Matter – 10 microns or less in diameter (PM_{10})	5
Particulate Matter – less than 2 microns in diameter ($PM_{2.5}$)	5
Sulfur Dioxide (SO_2)	0.3
Nitrogen Oxide (NO_X)	61
Carbon Monoxide (CO)	208
Lead (Pb)	<0.01
Volatile Organic Compounds (VOCs)	3
Hazardous Air Pollutants (HAPs)	1

Table 2.7-11
Initial Startup Emissions - Greenhouse Gases

Pollutant	Emissions (tons)
Carbon Dioxide (CO_2)	79,100
Methane (CH_4)	1
Nitrous Oxide (N_2O)	0.1
Carbon Dioxide Equivalent (CO_2-eq)	79,100

Venting or flaring would occur during regularly scheduled overhauls of the LNG train. A major overhaul would occur about every five years, based on the running time of the refrigerant compressors. During this overhaul, which lasts three to six weeks, several units in the LNG train would be inspected, preventative maintenance would be performed, and consumables such as molecular sieves, lube oils, and mercury removal beds may be replaced. After overhaul, the LNG train must be purged and restarted in a process similar to the initial startup, and emissions would be comparable.

Complete shutdown of the refrigerant compressors is not anticipated, based on ambient temperatures and recommended system operating specifications. In the event the refrigerant compressors are shut down, there would be no need to vent or flare the stored refrigerants. The methane refrigerant would be returned to the LNG tank vapor space. The propane refrigerant could be held in the refrigerant loop indefinitely. The ethylene could be stored for as long as a week in the LNG train before pressure would build up. Before this occurs, one LNG train would be started up so that the ethylene in the common ethylene vapor system could be cooled down as part of the process. As no purging of the refrigeration compressor turbines would occur as a result of intermittent shutdowns, no additional emissions are anticipated.

Air Modeling

In order to provide a more thorough evaluation of the potential impacts on air quality in the vicinity of the Project, Sabine Pass conducted a quantitative assessment of Project air emissions. The assessment included air dispersion modeling to predict off-site (i.e., ambient) concentrations in the vicinity of the Project resulting from the proposed emissions associated with operation of the Project. Because an air quality modeling analysis that quantifies the impacts of the Project is required as part of the air quality permit application process and has been submitted, we have used that modeling analysis for our evaluation of impacts. The modeling was conducted according to a modeling protocol describing the methodology and input data to be used, which was approved by LDEQ and USEPA Region VI.

Dispersion modeling of operational emissions followed USEPA PSD modeling requirements to evaluate potential air quality impacts within an area extending out to 50 kilometers from the facility. During the initial review of the Project by USEPA Region VI, it was determined that, due to the proximity of the Project to areas in Texas and Louisiana designated nonattainment or maintenance for the 8-hour ozone NAAQS and the projected level of NO_X (an ozone precursor), an analysis of the effect of the facility's proposed ozone precursor emissions on 8-hour ozone levels using photochemical grid modeling also should be conducted.

Each pollutant proposed to be emitted above a significant emission rate prescribed in the PSD regulation was modeled to determine whether its maximum ambient impact is above PSD significant impact levels (SILs) and monitoring de minimis levels. For any modeled results below the respective SIL, no additional modeling was required. For modeled results above the respective SIL, a full impact analysis, consisting of a comparison of modeled results to NAAQS and a PSD increment analysis, must be performed.

The full impact NAAQS analysis models the impact of the proposed project with other on-site sources, as well as existing off-site emission sources and a monitor-derived background concentration value. In this way, most emission source contributions of a pollutant at a particular site are considered in the analysis.

The PSD increment analysis is used to determine whether a proposed project would cause or contribute to an exceedance of the allowable decrease in air quality in conjunction with other existing sources constructed after a specified date known as a baseline date. Federal PSD guidelines specify allowable changes in air pollutant concentrations due to industrial expansion in an area; three allowable concentrations are specified based on each PSD Class designation. The facility is located in a controlled industrial growth area; therefore, the Class II increment value applies.

For the analysis to determine whether preconstruction monitoring is required, modeled results are compared to monitoring de minimis levels specified in the PSD regulation. If the modeled result is above a monitoring de minimis level, then one year of preconstruction ambient air pollutant monitoring must be conducted for the applicable pollutant; if below, no project/site monitoring is required.

For the PSD modeling study, the modeling was conducted using the USEPA's approved AERMOD with a five-year meteorological data set. AERMOD is the preferred guideline model for predicting impacts from new and modified stationary sources. Data sets input to this model include emission source parameter values (stack height and diameter, stack exhaust temperature and gas flow, and emission rate), building/structure dimensions for determining the effects of the buildings/structure on dispersion of emissions, receptor locations, terrain elevation data, and meteorological data. No receptors were placed within the facility fence line, because these are not considered "ambient-air" locations in accordance with modeling guidance.

SIL and Monitoring de minimis modeling was performed for pollutants emitted at rates above PSD significant emission rates. The pollutants modeled were PM_{10}, $PM_{2.5}$, NO_2, and CO. Modeling for SO_2 was not performed because emissions were below the significant emission rate. Table 2.7-12 summarizes the SIL modeling results. The SIL modeling results showed that 1-hour and annual average periods for NO_2 exceeded their respective SILs, requiring further analysis via a full impact analysis. No monitoring de minimis level was exceeded for any modeled pollutant/averaging period combination; therefore, no preconstruction ambient air quality monitoring was required.

Table 2.7-12
Significant Impact Level (SIL) Modeling Results

Criteria Pollutant	Averaging Period	Maximum ($\mu g/m^3$)	SIL ($\mu g/m^3$)	Monitoring de minimus Level ($\mu g/m^3$)
NO_2	1-hour[1]	61.9	7.5	-
	Annual[1]	2.64	1	14
CO	1-hour[1]	135	2,000	-
	8-hour[1]	58.8	500	575
PM_{10}	24-hour[1]	1.37	5	10
$PM_{2.5}$	24-hour[2]	1.17	1.2	4
	Annual[2]	0.19	0.3	-

Key:
1 = Maximum from modeled years 2003, 2004, 2006, 2008, and 2009.
2 = Average over modeled years 2003, 2004, 2006, 2008, and 2009.

The full impact analysis for 1-hour and annual average NO_2 requires the determination of the Project's area of influence (AOI). The AOI is an area defined by the furthest radial distance from the Project site where ambient air quality impacts drop below the respective SIL. For annual-period NO_2, the AOI is 3.84 kilometers. The annual NO_2 AOI is added to a 50-kilometer distance to define the area within which other emission sources must be included for the annual-period full impact analysis. The AOI for the 1-hour analysis is 10 kilometers without adding an additional 50 kilometers. The emission inventory of other (i.e., non-SPLNG Terminal) sources included in the full impact analysis were developed by Sabine Pass from LDEQ and TCEQ air permit databases.

For the full impact NAAQS analysis, the Project, existing SPLNG Terminal, and other off-property sources were modeled. To account for additional sources not explicitly modeled but that contribute to background NO_2 in the Project area, monitoring data from a representative monitoring site also was added to the full impact modeled results prior to comparison to the NAAQS. A monitor site located at Nederland High School (approximately 30 kilometers northwest of the SPLNG Terminal) was used as the background NO_2 site. Table 2.7-13 shows the results of the full impact NAAQS analysis for

NO_2. The combined concentration results for the 1-hour and annual average periods, when including background, are shown to be below the NAAQS.

Table 2.7-13
Full Impact National Ambient Air Quality Standards (NAAQS) Analysis for Nitrogen Dioxide (μg/m^3)

Averaging Period and Year of Highest Concentration	Modeled Concentration	Background Concentration	Combined Concentration	NAAQS
1-Hour (8th highest daily maximum 1-hour concentration, 5-year average)	106	60	166	188
Annual (2003)	30	10	40	100

For the NO_2 PSD Class II increment analysis, the analysis considered SPLNG Terminal-wide sources, as well as off-site emission sources in Louisiana and Texas. These sources were selected based on the AOI determined for the full impact analysis. A PSD Class II increment for annual NO_2 is used in the analysis; however, the USEPA has not yet established a PSD Class II increment for 1-hour NO_2. The results of the PSD increment analysis are shown in Table 2.7-14. The maximum modeled concentration for the annual average period is below (i.e., better than) the allowable value.

Table 2.7.14
Nitrogen Dioxide (NO_2) Prevention of Significant Deterioration (PSD) Class II Increment Analysis Results (μg/m^3)

Period and Year of Maximum	Modeled Concentration	PSD NO_2 Class II Increment
Annual (2003)	14	25

Sabine Pass conducted an Additional Impact Analysis as required by the PSD regulations. For the growth analysis, no significant commercial, residential, or industrial growth is expected as a result of construction of the facility. This would be due to a combination of factors, such as only modest permanent job growth, rural location of the facility, and either water or marshland surrounding the facility that would preclude additional development.

Secondary air quality standards are set under the CAA for the protection of soils, water, vegetation, animals, and other public welfare impacts. Sabine Pass's air quality analysis demonstrated that no secondary air quality standards would be violated; therefore, any impacts on soils, vegetation, animals, and other public welfare concerns would not be significant.

Visibility impacts were evaluated using the Visibility Screening (VISCREEN) model for the analysis. The closest open/active park, Sea Rim State Park, was selected for the visibility impact analysis. Visibility impacts at Sea Rim State Park were assessed using a conservative Level I (screening) analysis, followed by a refined analysis. The refined analysis was necessary because the visibility impacts determined via the Level I screening analysis were found to be above critical screening criteria. The refined analysis is more rigorous because it includes the use of regional meteorological data, annual PM and NO_X emission rates, a background ozone concentration value, and distances/angles that specify the relationship of the facility to Sea Rim State Park and a hypothetical observer. The results of the refined analysis are presented in Table 2.7-15 and show that projected visibility impacts are below (i.e., better than) critical screening levels, and no adverse visibility impacts are expected at Sea Rim State Park.

Table 2.7-15
Visibility Screening Analysis for Sea Rim State Park

Perceptibility of Plume Based on Color Difference, Maximum Modeled Value	Critical Screening Value, Color Difference	Maximum Modeled Contrast	Critical Screening Value, Contrast
1.6	2.0	0.01	0.05

We received comments regarding the Project's large potential NO_X and VOC emissions and the potential for ozone formation as a result. Photochemical grid modeling was performed to determine the impact on ozone concentrations for the 8-hour time period due to emissions from the Project. Although the USEPA has not issued formal guidance for conducting ozone modeling or interpretation of the results, Sabine Pass used methodology provided by USEPA Region VI. The Comprehensive Air Quality Model with Extensions (CAMx) was used for the analysis. The modeling concept to evaluate the Project was to re-model a previous attainment demonstration based on a known ozone episode (May 26 to July 1, 2006) with the proposed SPLNG NO_2 and VOC emissions added to the projected emission inventory. The analysis addresses impacts at known monitor locations and unmonitored locations.

Two initial runs of CAMx were performed to check that the model reproduced previous LDEQ CAMx results. The initial cases consisted of a model run for emissions in 2006 and a second run for a 2009 future case in which projected emissions are used (but do not include the Project) to establish design value concentrations at ozone monitor sites. A design value concentration is a pollutant concentration used as a basis for determining attainment of an air quality standard. Two additional simulations were performed to evaluate the impact from the proposed liquefaction facility. In both simulations, the 2009 future case emission data set was used with two scenarios of facility emissions added: one using estimated "most likely actual" facility emissions, and a second using estimated allowable facility emissions (i.e., emissions expected to be allowed by permit conditions).

The "most likely actual" emissions case included emissions from the refrigeration compressor gas turbines at 88.5% of maximum capacity, the marine, wet gas, and dry gas flares (five total flares), and emissions from one natural gas-fired turbine/generator. The 88.5% factor for the refrigeration turbines is based on a level of operation of the liquefaction process that would result in the maximum allowed LNG in the requested export license.

The "allowable emissions" scenario included all five flares, natural gas turbine driven refrigeration compressors, and both natural gas-fired generators operating at full capacity. This is an unlikely operating condition because it reflects operation of the facility at a level that would produce more LNG than allowed in the export license. It also includes operation of redundant capacity and spare equipment, which would not normally occur. The results from modeling allowable emissions likely overestimate the impact on ozone from the proposed facility, but were modeled because this represents the facility as permitted.

In Louisiana, the CAMx results for the "most likely actual" and "allowable emissions" scenarios showed that 8-hour ozone concentrations would increase at one monitoring station out of 23 statewide The increase would be 0.1 part per billion (ppb) from the 2009 future case design value of 75.5 ppb. In Texas, out of 33 monitor sites, 17 sites were shown to have an increase in the design value of 0.1 ppb or more for both SPLNG emission scenarios. Most of these monitor sites have design values in the 75 ppb to 80 ppb range. The maximum change for the "most likely actual" emission scenario was a 0.5 ppb increase at a monitor in Jefferson County Texas; the maximum change for the "allowable emission" scenario was a 0.6 ppb increase at the same monitor site.

In addition, four days of the modeled ozone episode period (May 26 to July 1, 2006) had a greater than 1.0 ppb increase at a limited number of on-land locations. There were no modeled increases of 2.0 ppb or higher.

For the unmonitored area analysis, the ozone concentration patterns are similar when comparing the baseline 2009 future case with the "most likely actual" and "allowable emissions" scenarios. However, differences between the 2009 future case and the SPLNG emission scenarios were found to be between an increase of 0.2 ppb and 1.0 ppb in 8-hour ozone design value concentrations in coastal areas.

The USEPA has not defined a significance threshold for ozone impacts, especially when evaluating a single facility's contribution to ozone impacts. The CAMx modeling performed by Sabine Pass has shown that the proposed liquefaction facility would result in small increases in ozone levels compared to existing (2006) and baseline 2009 future case design value concentrations at some monitoring sites and at some unmonitored locations. The potential impact on ozone levels in Louisiana would be minimal. The most pronounced impact on 8-hour ozone design value concentrations would be in Texas, because about one-half of the monitoring sites in the study area would show an ozone concentration increase with, some unmonitored areas potentially seeing an increase of up to 1.0 ppb. The increase in the design value concentrations would be less than 1% of the baseline 2009 future case design value concentrations. The results analysis does not show any new violations of the 8-hour ozone NAAQS and/or does not show an increase in the severity and/or frequency of violations. Therefore, we do not believe impacts on ozone from the Project would be significant.

2.7.2 Noise

Construction and operation of the Project facilities would affect the local noise environment. The ambient sound level of a region, which is defined by the total noise generated within the specific environment, is usually comprised of sounds emanating from both natural and artificial sources. At any location, both the magnitude and frequency of environmental noise may vary considerably over the course of the day and throughout the week, in part due to changing weather conditions and the impacts of seasonal vegetative cover.

Two measurements used by federal agencies to relate the time-varying quality of environmental noise to its known effect on people are the 24-hour equivalent sound level ($L_{eq(24)}$) and the day-night sound level (L_{dn}). The $L_{eq(24)}$ is an A-weighted sound level with the same total (equivalent) energy as the time-varying sound of interest, averaged over a 24-hour period. The L_{dn} takes into account the duration and time the noise is encountered. The L_{dn} is the $L_{eq(24)}$ with 10 decibels on the A-weighted scale (dBA) added to nighttime sound levels between the hours of 10 p.m. and 7 a.m. to account for people's greater sensitivity to sound during nighttime hours. The A-weighted scale is used because human hearing is less sensitive to low and high frequencies than mid-range frequencies.

In 1974, the USEPA published *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*. This document provides information for state and local governments to use in developing their own ambient noise standards. The USEPA has indicated that an L_{dn} of 55 dBA protects the public from indoor and outdoor activity interference. The criterion has been adopted by Sabine Pass to evaluate the potential noise impact of the compressor facilities at the nearest noise sensitive areas (NSAs), such as a residences, schools, or hospitals. Due to the 10 dBA nighttime penalty added prior to calculation of the L_{dn}, the actual constant noise level required to produce an L_{dn} of 55 dBA is lower, at 48.6 dBA $L_{eq(24)}$. Thus, for a facility to meet the L_{dn} 55 dBA limit, it must be designed such that actual noise levels do not exceed 48.6 dBA $L_{eq(24)}$ at any NSA. Also, in general, a person's threshold of perception for a perceivable change in loudness on the A-weighted sound level is on average 3 dBA, whereas a 5 dBA change is clearly noticeable and a 10 dBA change is perceived as either twice or half as loud.

Based on a review of state regulations, there are no applicable noise regulations for the LNG facilities constructed and operated in Louisiana.

2.7.2.1 Existing Noise Conditions

The Project would be located adjacent to the existing SPLNG Terminal. The area is bounded by the Sabine River on the west and south, and by wetlands to the north and east. No residences are within a 1-mile radius of the Project. Two NSAs that were identified during authorization of the existing SPLNG Terminal are located 6,150 feet or further from the nearest equipment at the Project. These locations include a marina (NSA 1) and the Sabine Pass Battleground State Historic Site (NSA 2). The Sabine Pass Battleground State Historic Site was extensively damaged by Hurricane Ike (2008) and no longer provides camping or overnight facilities. Sabine Pass Battleground State Historic Site was transferred to the Texas Historical Commission from Texas Parks and Wildlife Department, is no longer considered a Texas State Park, and has been removed from State Park status. However, the site is still open to the public and we continue to evaluate it as an NSA in the Project area.

Sabine Pass measured ambient noise at NSA 1 with the existing SPLNG Terminal in operation. Monitoring was conducted on March 25 and 26, 2010. The measured sound level at NSA 1 was 47.9 A-weighted dBA (L_{eq}), with a corresponding calculated day-night average sound level of 54.3 dBA (L_{dn}). The sound level measured at NSA 1 was used to characterize conditions at NSA 2 because NSA 2 is located adjacent to an industrial facility that is not part of the SPLNG Terminal. Table 2.7-16 shows the distance and direction from the Project to each NSA, the measured existing noise levels, and the calculated L_{dn} at each NSA.

Table 2.7-16
Existing Noise Levels
(in A-weighted decibels [dBA])

Noise-Sensitive Area	Approximate Distance to NSA (feet [a])	Direction	Measured L_{eq}	Equivalent L_{dn} Noise Levels
NSA 1: Marina	6,100	south	47.9	54.3
NSA 2: Site	7,100	south-southeast	47.9 [b]	54.3

Notes:
(a) Distance and direction from center of the Sabine Pass Liquefied Natural Gas Terminal site.
(b) Sound level measured at NSA 1 was used to characterize existing conditions at NSA 2 due to noise from an adjacent industrial facility near NSA 2.

2.7.2.2 Impacts and Mitigation

Construction Noise

Construction of Stage 1 of the Project would take approximately 55 months, and Stage 2 would be completed approximately six to nine months later. Construction noise is highly variable, as the types of equipment in use at a construction site change with the construction phase and the types of activities. Noise from construction activities may be noticeable at nearby NSAs; however, construction equipment would be operated on an as-needed basis during the short-term construction period. Nighttime noise levels are not expected to increase during construction because most construction activities would be limited to daylight hours. The most intense noise levels would be generated by pile-driving activities.

Sabine Pass used computer modeling to predict the sound level during typical construction activities. Equipment assumed for typical construction activities included cranes, backhoes, bulldozers, graders, and dump trucks. The projected short-term sound level at the nearest NSA during daytime construction would be 46 dBA L_{eq} or 52.4 dBA L_{dn}.

Sabine Pass also used computer modeling to predict the sound contribution of pile-driving activities. The predicted sound level due to pile-driving operations would be about 43 dBA L_{eq} or 49.4 dBA L_{dn} at the nearest NSA.

Construction noise modeling indicates that construction noise level contributions would be lower than the existing ambient levels at the NSAs. It is therefore anticipated that the short-term environmental noise impact from the Project would be minimal at the NSAs.

Operational Noise

Noise would generally be produced on a continuous basis at the Project site by the gas turbines, BOG compressors, and associated auxiliary equipment. Noise level data for the major facility sources were obtained from equipment vendors and/or from measurements of similar sources at other facilities. Although Sabine Pass proposes two stages for the Project operation, it performed computer modeling (the CadnaA model) using this equipment noise data to predict sound levels that would be generated by operation of the entire Project (both stages). The analysis accounted for spreading losses, ground and atmospheric effects, shielding from barriers and buildings, and reflections from surfaces.

Sabine Pass identified several mitigation measures that would be implemented to reduce noise levels from the Project. Table 2.7-17 presents acoustical characteristics of the noise control measures considered in the analysis.

Table 2.7-17
Acoustical Characteristics of Potential Noise Control Features

Noise Source	Control Measure	Acoustical Performance (decibels)								
		31.5	63	125	250	500	1k	2k	4k	8k
BOG Compressor Building Walls and Roof	STC-29 Wall System (TL)	8	12	11	16	26	34	41	44	46
Liquefaction Train Gas Turbine Exhaust	Exhaust Silencer (IL)	2	5	12	24	34	40	39	31	11
Power Generator Gas Turbine Exhaust	Exhaust Silencer (IL)	2	5	12	24	34	40	39	31	11
Liquefaction Train Piping	ISO Type B Lagging (IL)	0	0	0	2	11	20	29	36	42

Key:
BOG = boil-off gas.
IL = insertion loss.
ISO = International Organization of Standardization.
TL = transmission loss.

The results of the noise modeling for the entire SPLNG Terminal (existing LNG facility plus the Project) with the aforementioned noise control measures included is provided in Table 2.7-18. The results indicate that sound levels associated with operation of the SPLNG Terminal and the Project at the nearest NSA would be 54.1 dBA L_{dn}, which is below the FERC maximum L_{dn} of 55 dBA. Table 2.7-18 also presets a comparison of the existing noise levels, the combined future levels, and the expected increase in noise levels. However, this analysis was conservative in that the existing equipment appears to be considered twice (under the measured existing sound levels and again for predicted new and existing combined sound levels). The expected increases in sound levels at the NSAs are shown to conservatively range from 2.6 to 2.9 dBA. The expected increase is less that 3 dBA and would be barely perceptible. Although the combined noise levels with the existing ambient noise levels would exceed 55 dBA L_{dn}, the noise levels from the existing and new equipment at would be below 55 dBA L_{dn}. Therefore, we do not believe that noise impacts due to operation of the Project would be significant. However, to ensure that the actual noise resulting from operation of the staged Project facilities is not significant, **we recommend that:**

- **Sabine Pass should file a noise survey with the Secretary <u>no later than 60 days</u> after each stage of the Sabine Pass Liquefaction Project facilities are placed into service. If the noise attributable to operation of the SPLNG Terminal and liquefaction facilities exceeds an Ldn of 55 dBA at any nearby NSA, Sabine Pass should file a report on what changes are needed and should install additional noise controls to meet that level <u>within 1 year of the in-service date</u>. Sabine Pass should confirm compliance with the above requirement by filing a second noise survey with the Secretary <u>no later than 60 days</u> after it installs the additional noise controls.**

Table 2.7-18
Results of Noise Modeling Analysis
(in A-weighted decibels [dBA])

Noise-Sensitive Area	Calculated L_{dn} of Existing and Proposed Sources [(a)]	Existing L_{dn}	Combined L_{dn}	Expected Increase
NSA 1: Marina	54.1	54.3	57.2	2.9
NSA 2: Park	53.4	54.3	56.9	2.6

Note:
(a) Calculated sound level for the existing LNG facility and the proposed Liquefaction Plant.
Key:
L_{eq} = equivalent sound level.
L_{dn} = day-night averaged sound level.

2.8 Reliability and Safety

2.8.1 Regulatory Agencies

Three federal agencies share regulatory authority over the siting, design, construction, operation, and maintenance of LNG terminals: the U.S. Coast Guard, the USDOT, and the FERC. The Coast Guard has authority over the safety of an LNG facility's marine transfer area and LNG marine traffic, as well as over security plans for the entire LNG facility and LNG marine traffic. The USDOT has established federal safety standards for siting, construction, operation, and maintenance of onshore LNG facilities, as well as for the siting of marine cargo transfer systems at waterfront LNG plants. Those standards are codified in Title 49 CFR, Part 193. Under the NGA and delegated authority from the U.S. Department of Energy, the FERC authorizes the siting and construction of LNG import and export facilities.

In 1985, the FERC and USDOT entered into an MOU regarding the execution of each agency's respective statutory responsibilities to ensure the safe siting and operation of LNG facilities. In addition to FERC's existing ability to impose requirements to ensure or enhance the operational reliability of LNG facilities, the MOU specified that FERC may, with appropriate consultation with USDOT, impose more stringent safety requirements than those in Part 193.

In February 2004, the Coast Guard, USDOT, and FERC entered into an Interagency Agreement to ensure greater coordination among these three agencies in addressing the full range of safety and security issues at LNG terminals, including terminal facilities and tanker operations, and maximizing the exchange of information related to the safety and security aspects of the LNG facilities and related marine operations. Under the Interagency Agreement, the FERC is the lead federal agency responsible for the preparation of the analysis required under NEPA for impacts associated with terminal construction and operation. The USDOT and Coast Guard participate as cooperating agencies and assist in assessing any mitigation measures that may become conditions of approval for any project.

As part of the review required for a FERC authorization, Commission staff must ensure that all proposed facilities operate safely and securely and are designed in accordance with the applicable requirements set forth in the USDOT regulations in 49 CFR 193. The design information must be filed in the application to the Commission as specified by Title 18 CFR, § 380.12 (m) and (o). The level of detail necessary for this submittal requires the Project sponsor to perform substantial front-end engineering of the complete facility. The design information is required to be site-specific and developed to the extent that further detailed design would not result in changes to the siting considerations, basis of design, operating conditions, major equipment selections, equipment design conditions, or safety system designs considered by FERC staff during the review process.

The following sections contain the conclusions of FERC staff's reliability and safety analysis and incorporate the comments of the USDOT as a cooperating agency. In accordance with the working arrangements allowed by the 1985 MOU, the USDOT has reviewed FERC staff's analysis of the applicant's compliance with the requirements in Part 193, as well as FERC staff's recommended mitigation measures, and has no objections at this time.

Section 2.8.2 discusses the principal properties and hazards associated with LNG, refrigerants, and process fluids and byproducts; Section 2.8.3 discusses FERC staff's technical review of the preliminary design; Section 2.8.4 discusses siting requirements; Section 2.8.5 includes a siting analysis of hazards resulting from an LNG or refrigerant spill; Section 2.8.6 discusses emergency response; Section 2.8.7 discusses facility security; and Section 2.8.8 discusses LNG vessel safety.

2.8.2 Hazards

Before liquefaction, the natural gas would be pre-treated by an activated methyldiethanolamine (amine) system to remove carbon dioxide and hydrogen sulfide and by non-regenerable sulfur-impregnated carbon beds to remove mercury. The hazards associated with the removal of these substances from the natural gas stream result from the physical and chemical properties, flammability, and toxicity of the amine, carbon dioxide, hydrogen sulfide, and/or mercury.

The amine solution would be provided with containment, as discussed in Section 2.8.5, and would be handled at temperatures below the point at which it could produce enough vapors to form a flammable mixture. Therefore, the amine solution would not pose a significant hazard to the public, which would have no access to the on-site areas.

The amount of carbon dioxide, hydrogen sulfide, and mercury in the natural gas would be limited by pipeline tariffs with no more than 1.30 percent by volume (%-vol) carbon dioxide and 5 parts per million by volume (ppm-v) hydrogen sulfide. Sabine Pass proposes a design capacity to handle up to 2.00%-vol carbon dioxide, 16 ppm-v hydrogen sulfide, and less than 2.5 parts per billion by volume (ppb-v) mercury. The low quantities and concentrations of these substances in the natural gas would not pose a hazard to the public.

However, as the carbon dioxide and hydrogen sulfide are removed by the amine solution, these substances would accumulate within the amine and reduce the effectiveness of the system. Therefore, the amine solution would be regenerated periodically. During regeneration of the amine solution, concentrations as high as 92.9%-vol carbon dioxide and 0.1%-vol hydrogen sulfide would be vented to the atmosphere under controlled conditions. Sabine Pass would provide hydrogen sulfide detectors at the top of the amine regenerators and near the acid gas vent stack, where the highest concentrations of carbon dioxide and hydrogen sulfide would occur. However, Sabine Pass did not provide a vent stack dispersion analysis to determine the placement of hazard detection devices. FERC staff has provided a recommendation to address this issue in Section 2.8.3.

As the mercury is removed and accumulated in the sulfur-impregnated activated carbon beds, it forms mercuric sulfide which is stable and insoluble. Unlike the amine solution that requires regeneration, the sulfur-impregnated carbon in the beds would need to be replaced. The sulfur impregnated carbon beds would have enough capacity to last at least eight years before the beds would need to be replaced. Maintenance and safety procedures would cover the proper replacement and disposal of the mercuric sulfide within the carbon beds.

The principal hazards associated with the liquefaction and storage of LNG and refrigerants result from loss of containment, vapor dispersion characteristics, flammability, and the ability to produce damaging overpressures. A loss of the containment provided by storage tanks or process piping would result in the formation of flammable vapor at the release location, as well as from any LNG or liquid flammable refrigerant that pooled. Releases occurring in the presence of an ignition source would most likely result in a fire located at the vapor source. A spill without ignition would form a vapor cloud that would travel with the prevailing wind until it either dispersed below the flammable limits or encountered an ignition source. In some instances, ignition of a vapor cloud may produce damaging overpressures. These hazards are described in more detail below.

Loss of Containment

LNG would be stored on-site at atmospheric pressure and cryogenic temperature of approximately -260°F. Liquid ethylene would be stored on-site at approximately 45 psig and at a cryogenic temperature of approximately -109°F. Loss of containment of cryogenic liquids, such as LNG and ethylene, could lead to the release of both liquid and vapor into the immediate area. Exposure to either cold liquid or vapor could cause freeze burns and, depending on the length of exposure, more serious injury or death. However, spills would be contained to on-site areas and the cold state of these releases would be greatly limited due to the continuous mixing with the warmer air. The cold temperatures from the release would not present a hazard to the public, which would not have access to on-site areas.

LNG and ethylene are cryogenic liquids that would quickly cool any materials contacted by the liquid on release, causing extreme thermal stress in materials not specifically designed for such conditions. These thermal stresses could subsequently subject the material to brittleness, fracture, or other loss of tensile strength. These temperatures, however, would be accounted for in the design of equipment and structural supports, and would not be substantially different from the hazards associated with the storage and transportation of liquid oxygen (-296ºF) or several other cryogenic liquids that have been routinely produced and transported in the United States.

Liquid propane would be stored on-site at ambient temperature and elevated pressures, similar to the conditions typically used in propane storage and distribution. Temperatures as low as approximately -25°F would occur within the process stream, but the propane would not reach cryogenic temperatures. Due to the temperature and pressure conditions under which propane would be handled on-site, a loss of containment would result primarily in a vapor release. Although not cryogenic, contact with the rapidly expanding gas may still cause freeze burns or frostbite for personnel in the immediate area of the release. However, as with LNG and ethylene, the potential cold state of the release would not present an offsite hazard to the public.

Vapor Dispersion

In the event of a loss of containment, LNG, ethylene, and propane would vaporize on release from any storage or process facilities. Depending on the size of the release, cryogenic liquids, such as LNG and ethylene, may form a liquid pool and vaporize. Additional vaporization would result from exposure to ambient heat sources, such as water or soil. When released from a containment vessel or transfer system, LNG will generally produce 620 to 630 standard cubic feet of natural gas for each cubic foot of liquid. Ethylene will generally produce 475 to 485 standard cubic feet of gas for each cubic foot of liquid. Propane will generally produce 270 to 300 standard cubic feet of gas for each cubic foot of liquid.

If the loss of containment does not result in immediate ignition of the LNG, ethylene, or propane, the vapor cloud would travel with the prevailing wind until it either encountered an ignition source or dispersed below its flammable limits. An LNG release would form a denser-than-air vapor cloud that would sink to the ground due to the cold temperature of the vapor. As the LNG vapor cloud disperses downwind and mixes with the warm surrounding air, the LNG vapor cloud may become buoyant. However, experimental observations and vapor dispersion modeling indicate the LNG vapor cloud would not typically be warm, or buoyant, enough to lift off from the ground before the LNG vapor cloud disperses below its LFL. A liquid ethylene release would also form a denser-than-air vapor cloud that would sink to the ground due to the cold temperature of the vapor. As the ethylene vapor cloud disperses downwind and mixes with the warm surrounding air, the ethylene vapor would become neutrally buoyant. A propane release would form a denser-than-air vapor cloud that would sink to the ground; however, propane would remain denser than the surrounding air, even after warming to ambient temperatures.

Methane, propane, and ethylene are classified as simple asphyxiants and may pose extreme health hazards, including death, if inhaled in significant quantities within a limited time. Very cold methane, propane, or ethylene vapors may also cause freeze burns. However, the locations of concentrations where cold temperatures and oxygen-deprivation effects could occur are greatly limited due to the continuous mixing with the warmer air surrounding the spill site. For that reason, exposure injuries from contact with releases of methane, ethylene, or propane normally represent negligible risks to the public.

Vapor Cloud Ignition

Flammability of the vapor cloud is dependent on the concentration of the vapor when mixed with the surrounding air. In general, higher concentrations within the vapor cloud would exist near the spill, and lower concentrations would exist near the edge of the cloud as it disperses downwind. Mixtures occurring between the LFL and the UFL can be ignited. Concentrations above the UFL or below the LFL would not ignite.

The LFL and UFL for methane are approximately 5%-vol and 15%-vol in air, respectively. Propane has a narrower flammability range, but has a lower LFL of approximately 2.1%-vol and a UFL of 9.5%-vol in air. Ethylene has a much wider flammability range and a lower LFL of approximately 2.7%-vol and a UFL of 36%-vol in air.

If the flammable portion of a vapor cloud encounters an ignition source, a flame would propagate through the flammable portions of the cloud. In most circumstances, the flame would be driven by the heat it generates. This process is known as a deflagration. An LNG vapor cloud deflagration in an uncongested and unconfined area travels at slower speeds and does not produce significant pressure waves. However, exposure to this LNG vapor cloud fire can cause severe burns and death, and can ignite combustible materials within the cloud. Confined and congested LNG, propane, and ethylene vapor clouds may produce higher flame speeds and overpressures, and are discussed later in this Section under "Overpressures."

A deflagration may propagate back to the spill site if the vapor concentration along this path is sufficiently high to support the combustion process. When the flame reaches vapor concentrations above the UFL, the deflagration could transition to a fireball and result in a pool or jet fire back at the source. A fireball would occur near the source of the release and would be of a relatively short duration compared to an ensuing jet or pool fire.

The extent of the affected area and the severity of the impacts on objects either within an ignited cloud or in the vicinity of a pool fire would primarily be dependent on the quantity and duration of the initial release, the surrounding terrain, and the environmental conditions present during the dispersion of the cloud. Radiant heat and dispersion modeling are discussed in Section 2.8.5.

Fires may also cause failures of nearby storage vessels, piping, and equipment. The failure of a pressurized vessel could cause fragments of material to fly through the air at high velocities, posing damage to surrounding structures and a hazard for operating staff, emergency personnel, or other individuals in proximity to the event. In addition, failure of a pressurized vessel when the liquid is at a temperature significantly above its normal boiling point could result in a boiling-liquid-expanding-vapor explosion (BLEVE). BLEVEs of flammable liquids can produce overpressures and a subsequent fireball when the superheated liquid rapidly changes from a liquid to a vapor upon the release from the vessel. Atmospheric storage tanks are unlikely to BLEVE due to the smaller difference between their design pressure and ambient pressure.

Overpressures

If the deflagration in a flammable vapor cloud accelerates to a sufficiently high rate of speed, pressure waves that can cause damage would be generated. As a deflagration accelerates to super-sonic speeds, the large shock waves produced, rather than the heat, would begin to drive the flame, resulting in a detonation. The flame speeds are primarily dependent on the reactivity of the fuel, the ignition strength and location, the degree of congestion and confinement of the area occupied by the vapor cloud, and the flame travel distance.

The potential for unconfined LNG vapor cloud detonations was investigated by the Coast Guard in the late 1970s at the Naval Weapons Center at China Lake, California. Using methane, the primary component of natural gas, several experiments were conducted to determine whether unconfined LNG vapor clouds would detonate. Unconfined methane vapor clouds ignited with low-energy ignition sources (13.5 J), produced flame speeds ranging from 12 to 20 mph. These flame speeds are much lower than the flame speeds associated with a deflagration with damaging overpressures or a detonation.

To examine the potential for detonation of an unconfined natural gas cloud containing heavier hydrocarbons that are more reactive, such as ethane and propane, the Coast Guard conducted further tests on ambient-temperature fuel mixtures of methane-ethane and methane-propane. The tests indicated that the addition of heavier hydrocarbons influenced the tendency of an unconfined natural gas vapor cloud to detonate. Less processed natural gas with greater amounts of heavier hydrocarbons would be more sensitive to detonation.

Although it has been possible to produce damaging overpressures and detonations of unconfined LNG vapor clouds, the natural gas delivered by pipeline for liquefaction and export would have lower ethane and propane concentrations than those that resulted in damaging overpressures and detonations. The substantial amount of initiating explosives needed to create the shock initiation during the limited range of vapor-air concentrations also renders the possibility of detonation of these vapors at an LNG plant as unrealistic. Consequently, the primary hazards to the public from an LNG spill, either on land or water, would be from dispersion of the flammable vapors or from radiant heat generated by a pool fire.

In comparison with LNG vapor clouds, there is a higher potential for unconfined propane clouds to produce damaging overpressures, and an even higher potential for unconfined ethylene vapor clouds to produce damaging overpressures. Unconfined ethylene vapor clouds also have the potential to transition to a detonation much more readily than propane. This has been shown by multiple experiments conducted by the Explosion Research Cooperative to develop predictive blast wave models for low, medium, and high reactivity fuels and varying degrees of congestion and confinement. The experiments used methane, propane, and ethylene, as the respective low, medium, and high reactivity fuels. In addition, the tests showed that if methane, propane, or ethylene is ignited within a confined space, such as in a building, they all have the potential to produce damaging overpressures.

The extent of the affected area and the severity of impacts from ignition of a vapor cloud would primarily be dependent on the reactivity of the fuel, the ignition strength and location, the degree of congestion and confinement of the area occupied by the vapor cloud, and the flame travel distance. The extent of damaging overpressure from ignition of a vapor cloud is covered in Section 2.8.5.

Past LNG Incidents

With the exception of the October 20, 1944, failure at an LNG facility in Cleveland, Ohio, the operating history of the U.S. LNG industry has been free of safety-related incidents resulting in adverse effects on the public or the environment. The 1944 incident in Cleveland led to a fire that killed 128 people and injured 200-400 people.[4] The failure of the LNG storage tank was due to the use of materials inadequately suited for cryogenic temperatures. LNG migrating through streets and into underground sewers due to the lack of adequate spill impoundments at the site was also a contributing factor. Current regulatory requirements ensure that proper materials suited for cryogenic temperatures are used and that spill impoundments are designed and constructed properly to contain a spill at the site.

Another operational accident occurred in 1979 at the Cove Point LNG facility in Lusby, Maryland. A pump seal failure resulted in gas vapors entering an electrical conduit and settling in a confined space. When a worker switched off a circuit breaker, the gas ignited, causing heavy damage to the building and a worker fatality. With the participation of the FERC, lessons learned from the 1979 Cove Point accident resulted in changing the national fire codes to ensure that the situation would not occur again.

On January 19, 2004, a blast occurred at Sonatrach's Skikda, Algeria, LNG liquefaction facility, which killed 27 and injured 56 workers. No members of the public were injured. Preliminary findings of the accident investigation suggested that a cold hydrocarbon leak occurred at Liquefaction Train 40 and was introduced to the high-pressure steam boiler by the combustion air fan. An explosion developed inside the boiler firebox, which subsequently triggered a larger explosion of the hydrocarbon vapors in the immediate vicinity. The resulting fire damaged the adjacent liquefaction process and liquid petroleum gas (LPG) separation equipment of Train 40, and spread to Trains 20 and 30. Although Trains 10, 20, and 30 had been modernized in 1998 and 1999, Train 40 had been operating with its original equipment since start-up in 1981. To ensure that this potential hazard would be addressed, all combustion and ventilation air intake equipment would be required to have hazard detection devices that would enable isolation and deactivation of any combustion equipment whose continued operation could add to or sustain an emergency.

2.8.3 Technical Review of the Preliminary Engineering Design

Operation of the proposed liquefaction facilities poses a potential hazard that could affect the public safety if strict design and operational measures to control potential accidents are not applied. The primary concerns are those events that could lead to an LNG or refrigerant spill of sufficient magnitude to create an off-site hazard as discussed in Section 2.8.2. However, it is important to recognize the stringent

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4 For a description of the incident and the findings of the investigation, see "U.S. Bureau of Mines, Report on the Investigation of the Fire at the Liquefaction, Storage, and Regasification Plant of the East Ohio Gas Co., Cleveland, Ohio, October 20, 1944," dated February 1946.

requirements in place for the design, construction, operation, and maintenance of the facility, as well, as the extensive safety systems proposed to detect and control potential hazards.

As part of a project's preliminary safety review, a hazard identification (HAZID) analysis of the Front-End Engineering Design (FEED) design is conducted to identify the major hazards that may be encountered during the operation of facilities. In addition, a hazard and operability (HAZOP) study of the completed design would also be performed during the detailed design phase. A HAZOP is done to address hazards of the process, engineering and administrative controls, and a qualitative evaluation of a range of possible safety, health, and environmental effects which may result from the design or operation of the facility. Recommendations to prevent or minimize these hazards would be generated from the results of the HAZOP review. These studies would help establish the required safety control levels and identify whether additional process and safety instrumentation would be needed.

Management of Change (MOC) procedures would be initiated to track changes in the facility design, operations, documentation, and personnel. These changes would be evaluated to ensure that the safety, health, and environmental risks arising from these changes are addressed and controlled. The MOC would also track resolution of the recommendations generated by the HAZOP review.

Based on these analyses, facilities are designed with various layers of protection or safeguards to reduce the risk of a potentially hazardous scenario from developing into an event that could impact the off-site public. These layers of protection are independent of one another so that anyone would perform its function regardless of the action or failure of any other protection layer or initiating event. These layers of protection typically include:

(1) A facility design that prevents hazardous events through the use of suitable materials of construction; operating and design limits for process piping, process vessels, and storage tanks; adequate seismic design; appropriate electrical area classification; and proper equipment and building spacing;

(2) Control systems, including monitoring systems and process alarms, remotely-operated control and isolation valves, and operating procedures to ensure the facility stays within the established operating and design limits;

(3) Safety-instrumented prevention systems, such as safety control valves and emergency shutdown systems, to prevent a release if operating and design limits are exceeded;

(4) Physical protection systems, such as pressure relief valves, spill containment, and structural fire protection, to prevent escalation to a more severe event;

(5) Site security measures for controlling access to the facility, including security inspections and patrols; response procedures to any breach of security; and liaison with local law enforcement officials; and

(6) On-site and off-site emergency response, including hazard detection and control equipment, firewater systems, and coordination with local first responders to mitigate the consequences of a release and prevent it from escalating to an event that could impact the public.

The use of these protection layers would mitigate the potential for a process upset to develop into an event that could damage the facility, injure operating staff, or impact the safety of the off-site public. In addition, proper siting of the facility with regard to potential off-site consequences is necessary to ensure that the public is protected. These siting requirements are discussed in Section 2.8.4.

As part of the application, Sabine Pass provided a FEED for the Project. The FEED and specifications submitted for the proposed facilities to date are preliminary, but would serve as the basis for any detailed design to follow. During the FERC review process, FERC staff analyzed the information filed by Sabine Pass to determine the extent that layers of protection or safeguards to enhance the safety, operability, and reliability of the facility are included in the FEED.

In response to staff's questions on the FEED, Sabine Pass filed supplemental information concerning the preliminary design. However, some of the responses indicated that some additional corrections or modifications would be made to the design to address issues raised in the information request. These responses are referenced in Table 2.8-1. As a result, **we recommend that**:

- **Sabine Pass should file with the Secretary, for review and approval by the Director of OEP, information/revisions as described in Sabine Pass' responses to the Engineering Information Requests identified in Table 2.8-1 of the Environmental Assessment. This information should be filed <u>prior to construction of final design</u>.**

Table 2.8-1
Sabine Pass Responses Indicating Corrections or Modifications to the FEED Design

Date of FERC Engineering Information Request	FERC Engineering Information Request	Filing Date of Sabine Pass Response
March 30, 2011	Enclosure 1: Request 4, 13, 17, and 29	April 19, 2011, and July 28, 2011
	Enclosure 2: Request 7 and 9	April 19, 2011
November 8, 2011	Enclosure: Request 11	November 18, 2011

The objectives of our FEED review focused on the engineering design and safety concepts of the various protection layers, as well as the projected operational reliability of the proposed facilities. The design would use materials of construction suited to the pressure and temperature conditions of the process design. The facility would also be designed to withstand the effects of hurricane force winds with a design wind velocity of 155 mph for the process equipment containing LNG and refrigerants, per the requirements of ASCE 7-10, Minimum Design Loads for Buildings and Other Structures. Pipe supports for cryogenic piping and process equipment would be elevated to 18.5 feet above sea level (NAVD 88 survey standard) to minimize the risk of flooding. The finished floor of critical buildings would be elevated to 19 feet above sea level. The existing terminal was constructed to account for similar flood elevation allowances. As discussed in Section 2.1.1, the seismic and structural design of the facility was also examined.

Process control valves and instrumentation would be installed to safely operate and monitor the pre-treatment and liquefaction systems. Alarms would have visual and audible notification in the control room to warn the operators that process conditions may be approaching design limits. Operators would have the capability to take action from the control room to mitigate an upset. An alarm management program would also be in place to ensure the effectiveness of the alarms. Sabine Pass would update the existing facility operations procedures to include the pre-treatment and liquefaction facilities and would provide these updates for review after completion of the final design. Additional safety valves and instrumentation would be installed to monitor, alarm, shutdown, and isolate equipment and piping during process upsets or emergency conditions.

Pressure relief valves, vent stacks, and flares would be installed to protect the process equipment and piping. The pressure relief valves would be designed to handle process upsets and thermal expansion within piping, per NFPA 59A and ASME Section VIII, and would be designed based on API 521. Additionally, LNG and process facilities would be provided with a drainage system or spill system designed to direct a spill away from equipment in order to minimize heat flux damage to adjacent equipment if an ignition occurs. Impoundment systems are discussed in Section 2.8.5.

The existing security fencing, lighting, and camera systems would be expanded to cover the liquefaction trains. As discussed in Section 2.8.7, Sabine Pass would be required to update the existing Facility Security Plan to address changes associated with the Liquefaction Project.

In the event of a fire or leak, systems would also be installed to detect, alarm, and alert personnel in the area and control room to initiate appropriate procedures. Sabine Pass performed a preliminary fire protection evaluation to ensure that adequate hazard detection, hazard control, and firewater coverage would be installed to detect and address any upset conditions. Additionally, Sabine Pass performed a firewater network analysis and determined the existing firewater system is adequately sized for the additional demands from the proposed liquefaction facilities. However, Sabine Pass did not examine simultaneous fires in the existing and proposed facilities. FERC staff recommends additional analysis of the existing and proposed facilities later in this section.

As discussed in Section 2.8.6, Sabine Pass has an existing ERP that has been in place since the SPLNG Terminal began operation in April 2008. The existing ERP would need to be updated to include the proposed liquefaction facilities and related emergencies.

If authorization is granted by the Commission, the next phase of the Project would include development of the final design, including final selection of equipment manufacturers, process conditions, and resolution of some safety-related issues. To ensure the final design would be consistent with the safety and operability characteristics identified in the FEED, information regarding the development of the final design, as detailed below, would need to be filed with the Secretary for review and written approval by the Director of OEP before equipment construction at the site would be authorized.

In addition to final design review, FERC staff would conduct inspections during construction and would review additional materials, including quality assurance and quality control plans, non-conformance reports, and cooldown and commissioning plans to ensure that the installed design would be consistent with the safety and operability characteristics of the FEED. FERC staff would also conduct inspections during operation to ensure that the facility would be operated and maintained in accordance with the filed design throughout the life of the facility.

To ensure that the concerns identified by FERC staff relating to the reliability, operability, and safety of the proposed design are addressed by Sabine Pass, and to ensure that the facility is subject to the Commission's construction and operational inspection program, **we recommend that**:

The following measures should apply to the Sabine Pass LNG terminal. Information pertaining to these specific recommendations should be filed with the Secretary for review and written approval by the Director of OEP either: prior to initial site preparation; prior to construction of final design; prior to commissioning; or prior to introduction of natural gas or process fluids, as indicated by each specific condition. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 683 (Docket No. RM06-24-000), including security information, should be submitted as critical energy infrastructure information (CEII) pursuant to 18 CFR 388.112. See Critical Energy Infrastructure Information, Order No. 683, 71 FR 58,273 (October 3, 2006), FERC Stats. & Regs. ¶31,228 (2006). Information pertaining to items such as off-site emergency response, procedures for public notification and evacuation, and construction and operating reporting requirements would be subject to public disclosure. All information should be filed a minimum of 30 days before approval to proceed is requested.

- **A complete plan and list of the hazard detection equipment should be filed <u>prior to initial site preparation</u>. The information should include a list with the instrument tag number, type and location, alarm locations, and shutdown functions of the proposed hazard detection equipment. Plan drawings should clearly show the location of all detection equipment.**

- **<u>Prior to initial site preparation</u>, Sabine Pass should file a technical review of its proposed facility design that:**

    a. **Identifies all combustion/ventilation air intake equipment and the distances to any possible flammable release (i.e., LNG, flammable refrigerants, flammable liquids and flammable gases).**

    b. **Demonstrates that these areas are adequately covered by hazard detection devices and indicates how these devices would isolate or shut down any combustion equipment whose continued operation could add to or sustain an emergency.**

- **A complete plan and list of the fixed and wheeled dry-chemical, fire extinguishing, and high-expansion-foam hazard control equipment should be filed <u>prior to initial site preparation</u>. The information should include a list with the equipment tag number, type, size, equipment covered, and automatic and manual remote signals initiating discharge of the units. Plan drawings should clearly show the planned location of all fixed and wheeled extinguishers.**

- **Facility plans showing the proposed location of, and area covered by, each monitor, hydrant, deluge system, hose, and sprinkler, as well as piping and instrumentation diagrams of the firewater system, should be filed <u>prior to initial site preparation</u>.**

- **An overall project schedule, which includes the proposed stages of the commissioning plan, should be filed <u>prior to initial site preparation</u>.**

- **The <u>final design</u> of the fixed and wheeled dry-chemical fire extinguishing equipment and high-expansion-foam hazard control equipment should identify manufacturer and model.**

- **The <u>final design</u> should include an updated fire protection evaluation of the existing and proposed facilities carried out in accordance with the requirements of National Fire Protection Association (NFPA) 59A 2001, chapter 9.1.2. The evaluation should assess the potential need for additional firewater capacity to address multiple fire scenarios occurring in different locations of the plant and occurring simultaneously.**

- **The <u>final design</u> should demonstrate the ability to provide firewater coverage for Case 1 and Case 2 of the Firewater Network Analysis, filed on April 19, 2011, for the proposed liquefaction facilities.**

- **The <u>final design</u> should include an acid gas vent stack dispersion analysis to determine the proper placement of hazard detection devices that ensures venting is done in a safe manner.**

- **The <u>final design</u> should provide up-to-date Piping and Instrument Diagrams (P&IDs), which include the following information:**

    a. **equipment tag number, name, size, duty, capacity, and design conditions;**

    b. **equipment insulation type and thickness;**

    c. **refrigerant storage tank pipe penetration size or nozzle schedule;**

    d. **piping with line number, piping class specification, size, and insulation type and thickness;**

    e. **piping specification breaks and insulation limits;**

    f. **all control and manual valves numbered;**

    g. **relief valves with set points; and**

h. drawing revision number and date.

- **The final design should include details of the shutdown logic, including cause-and-effect matrices for alarms and shutdowns.**
- **The final design of the LNG storage tank piping and supports should be reviewed and approved by the tank manufacturer to verify the existing design is adequate to support the higher rated in-tank pump flow rates.**
- **The final design should specify that the Waste Heat Recovery Unit coil design temperature, at the design pressure, is consistent with the maximum design temperature of the turbine exhaust.**
- **The final design should include a relief valve study to ensure the existing LNG storage tank vacuum relief valves provide adequate protection with the higher capacity in-tank pumps operating at full capacity.**
- **The final design should specify that for LNG, natural gas, and refrigerant service, stainless steel and carbon steel branch piping and piping nipples are consistent with the existing facility's specifications.**
- **The final design should include a hazard and operability review of the completed design. A copy of the review and a list of recommendations, and actions taken on the recommendations should be filed.**
- **The final design should provide P&IDs, specifications, and procedures that clearly show and specify the tie-in details required to safely connect the Stage 2 facilities.**
- **The final design of the hazard detectors should account for the calibration gas when determining the Lower Flammability Limit (LFL) set points for methane, propane, and ethylene.**
- **The final design should include a plan for clean-out, dry-out, purging, and tightness testing. This plan should address the requirements of the American Gas Association's Purging Principles and Practice required by 49 CFR 193 and should provide justification for not using an inert or non-flammable gas for clean-out, dry-out, purging, and tightness testing.**
- **All valves, including drain, vent, instrument root, main, and car sealed valves, should be tagged in the field prior to commissioning.**
- **A tabulated list of the proposed hand-held fire extinguishers should be filed prior to commissioning. The lists should include the equipment tag number, type, size, number, and location. The type, size, and tag number of all hand-held fire extinguishers should be shown on facility plot plan(s).**
- **Operation and maintenance procedures and manuals, as well as safety procedure manuals, should be filed prior to commissioning.**
- **Sabine Pass should complete the firewater system coverage test prior to commissioning. The actual coverage area from each monitor and hydrant should be shown on the facility plot plan(s).**
- **Sabine Pass should complete all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, and Site Integration Tests) associated with the Distributed Control System (DCS) that demonstrates full functionality and operability of the system prior to commissioning.**
- **Sabine Pass should maintain a detailed training log to demonstrate that operating staff has completed the required training prior to commissioning.**

- **Sabine Pass should file a copy of the Mechanical Completion Certificate and any documentation (i.e., punch list items) that certifies that the facility is installed and mechanically tested according to the final design and specifications prior to commissioning.**
- **Sabine Pass should file a plan for completing functional and operational tests of the final design prior to commissioning.**
- **Sabine Pass should complete instrumentation functional tests, hazard detection equipment functional tests, and emergency shutdown (ESD) tests prior to introduction of natural gas or process fluids.**
- **Sabine Pass should receive written authorization from the Director of OEP prior to introducing natural gas or process fluids into the Project facilities. At a minimum, instrumentation and controls, hazard detection, hazard control, and security components/systems should be installed and functional.**
- **Progress on the construction of the LNG terminal should be reported in monthly reports filed with the Secretary. Details should include a summary of activities, problems encountered, contractor non-conformance/deficiency logs, remedial actions taken, and current project schedule. Problems of significant magnitude should be reported to the FERC within 24 hours.**

In addition, we recommend that the following measures should apply throughout the life of the facility:

- **The facility should be subject to regular FERC staff technical reviews and site inspections on at least an annual basis or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, Sabine Pass should respond to a specific data request, including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed piping and instrumentation diagrams reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted semi-annual report, should be submitted.**
- **Semi-annual operational reports should be filed with the Secretary to identify changes in facility design and operating conditions, abnormal operating experiences, activities (including ship arrivals, quantity and composition of imported and exported LNG, liquefied and vaporized quantities, boil-off/flash gas, etc.), plant modifications, including future plans and progress thereof. Abnormalities should include, but not be limited to: unloading/loading/shipping problems, potential hazardous conditions from off-site vessels, storage tank stratification or rollover, geysering, storage tank pressure excursions, cold spots on the storage tanks, storage tank vibrations and/or vibrations in associated cryogenic piping, storage tank settlement, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, vapor or liquid releases, fires involving natural gas and/or from other sources, negative pressure (vacuum) within a storage tank and higher than predicted boil-off rates. Adverse weather conditions and the effect on the facility also should be reported. Reports should be submitted within 45 days after each period ending June 30 and December 31. In addition to the above items, a section entitled "Significant Plant Modifications Proposed for the Next 12 Months (dates)" also should be included in the semi-annual operational reports. Such information would provide FERC staff with early notice of anticipated future construction/maintenance projects at the LNG facility.**

- **Significant non-scheduled events, including safety-related incidents (e.g., LNG, refrigerant, or natural gas releases, fires, explosions, mechanical failures, unusual over pressurization, and major injuries) and security-related incidents (e.g., attempts to enter site, suspicious activities) should be reported to FERC staff. In the event an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification should be made immediately, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification should be made to FERC staff within 24 hours. This notification practice should be incorporated into the LNG facility's emergency plan. Examples of reportable LNG or refrigerant related incidents include:**

  a. **fire;**

  b. **explosion;**

  c. **estimated property damage of $50,000 or more;**

  d. **death or personal injury necessitating in-patient hospitalization;**

  e. **release of LNG or refrigerants for five minutes or more;**

  f. **unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes gas, refrigerants, or LNG;**

  g. **any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes gas, refrigerants, or LNG;**

  h. **any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes gas, refrigerants, or LNG to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure limiting or control devices;**

  i. **a leak in an LNG facility that contains or processes gas, refrigerants, or LNG that constitutes an emergency;**

  j. **inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;**

  k. **any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or an LNG facility that contains or processes gas, refrigerants, or LNG;**

  l. **safety-related incidents to LNG or refrigerant vessels occurring at or en route to and from the LNG facility; or**

  m. **an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan.**

  In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property or the environment, including authority to direct the LNG facility to cease operations. Following the initial company notification, FERC staff would determine the

need for a separate follow-up report or follow-up in the upcoming semi-annual operational report. All company follow-up reports should include investigation results and recommendations to minimize a reoccurrence of the incident.

2.8.4 Siting Requirements

The Commission's regulations under 18 CFR § 380.12(o)(14) require Sabine Pass to identify how the proposed design complies with the siting requirements of 49 CFR 193, Subpart B. Those requirements state that an operator or governmental authority must exercise control over the activities that can occur within an "exclusion zone," defined as the area around an LNG facility that could be exposed to specified levels of thermal radiation or flammable vapor in the event of a release. Approved mathematical models must be used to calculate the dimensions of these exclusion zones. The 2001 edition of NFPA 59A, an industry consensus safety standard for the siting, design, construction, operation, maintenance, and security of LNG facilities, is incorporated into Part 193 by reference, with regulatory preemption in the event of conflict. The following sections of Part 193 specifically address siting requirements for each LNG container and LNG transfer system:

- Part 193.2051, Scope, states that each LNG facility designed, replaced, relocated or significantly altered after March 31, 2000, must be provided with siting requirements in accordance with Subpart B and NFPA 59A. In the event of a conflict with NFPA 59A, the regulatory requirements in Part 193 prevail.
- Part 193.2057, Thermal radiation protection, requires that each LNG container and LNG transfer system have thermal exclusion zones in accordance with Section 2.2.3.2 of NFPA 59A.
- Part 193.2059, Flammable vapor-gas dispersion protection, requires that each LNG container and LNG transfer system have a dispersion exclusion zone in accordance with Sections 2.2.3.3 and 2.2.3.4 of NFPA 59A.

For the following LNG facilities that are proposed for this Project, we identified that the siting requirements from Part 193 and NFPA 59A would be applicable to the following equipment:

- Two 6,574-gpm LNG transfer pumps per liquefaction train and associated piping; and
- Ten 7,045-gpm LNG in-tank pumps, which would replace two out of the three 4,304-gpm existing in-tank pumps in each LNG storage tank, and associated piping.

FERC staff has previously identified certain inconsistencies and areas of potential conflict between the requirements in Part 193 and NFPA 59A. Sections 193.2057 and 2059 require exclusion zones for each LNG container and LNG transfer system, and an LNG transfer system is defined in section 193.2007 to include cargo transfer system and transfer piping (whether permanent or temporary). However, NFPA 59A requires exclusion zones only for "transfer areas," which is defined as the part of the plant where the facility introduces or removes the liquids, such as truck loading or ship unloading areas. The NFPA 59A definition does not include permanent plant piping, such as cargo transfer lines. Section 2.2.3.1 of NFPA also states that transfer areas at the water edge of marine terminals are not subject to the siting requirements in that standard.

The USDOT recently addressed some of these issues in a March 2010 letter of interpretation.[5] In that letter, USDOT stated that: 1) the requirements in the 2001 NFPA 59A for transfer areas for LNG

5 PHMSA Interpretation "Re: Application of the Siting Requirements in Subpart B of 49 CFR Part 193 to the Mount Hope Bay Liquefied Natural Gas Transfer System" (March 25, 2010).

applied to the marine cargo transfer system at a proposed waterfront LNG facility, except where preempted by the regulations in Part 193; 2) the regulations in Part 193 for LNG transfer systems conflicted with the 2001 NFPA 59A on whether an exclusion zone analysis was required for transfer piping or permanent plant piping; and 3) the regulations in Part 193 prevailed as a result of that conflict. The USDOT determined that an exclusion zone analysis of the marine cargo transfer system is required.

FERC staff has also previously noted that when the USDOT incorporated NFPA 59A into its regulations, it removed the regulation that required impounding systems around transfer piping. As a result of that change (and based on certain statements in the preamble to the final rule), a question has arisen as to whether Part 193 or NFPA 59A requires impoundments for LNG transfer systems. FERC staff notes that Part 193 requires exclusion zones for LNG transfer systems, and that those zones are calculated based on impoundment systems. FERC further notes that the omission of containment for transfer piping is not a sound engineering practice. For these reasons, the FERC staff requires containment for all LNG transfer piping within a plant's property lines.

Federal regulations issued by OSHA under 29 CFR 1910.119 (Process Safety Management of Highly Hazardous Chemicals; Explosives and Blasting Agents (PSM)), and the USEPA under 40 CFR 68 (Risk Management Plans) cover flammable liquids, such as propane and ethylene at many facilities in the U.S. However, on October 30, 1992, shortly after the promulgation of the OSHA Process Safety Management regulations, OSHA issued a letter of interpretation that precluded the enforcement of PSM regulations over gas transmission and distribution facilities. In a subsequent letter on December 9, 1998, OSHA further clarified that this letter of interpretation applies to LNG distribution and transmission facilities.

In addition, the USEPA's preamble to its final rule in the Federal Register, Volume 63, Number 3, 639-645, clarified that exemption from the requirements in 40 CFR 68 for regulated substances in transportation, including storage incident to transportation, is not limited to pipelines. The preamble further clarified that the transportation exemption applies to LNG facilities subject to oversight or regulation under 49 CFR 193, including facilities used to liquefy natural gas or used to transfer, store, or vaporize LNG in conjunction with pipeline transportation. Therefore, the above OSHA and USEPA regulations are not applicable to facilities regulated under 49 CFR 193. As stated in § 193.2051, LNG facilities must be provided with the siting requirements of NFPA 59A (2001 edition). The siting requirements for flammable liquids within an LNG facility are contained in NFPA 59A, Chapter 2:

- NFPA 59A Section 2.1.1 requires consideration of clearances between flammable refrigerant storage tanks, flammable liquid storage tanks, structures and plant equipment, both with respect to plant property lines and each other. This section also requires that other factors applicable to the specific site that have a bearing on the safety of plant personnel and surrounding public be considered, including an evaluation of potential incidents and safety measures incorporated in the design or operation of the facility.
- NFPA 59A Section 2.2.2.2 requires impoundments serving flammable refrigerants or flammable liquids to contain a 10-minute spill of a single accidental leakage source or during a shorter time period based upon demonstrable surveillance and shutdown provisions acceptable to the USDOT. In addition, NFPA Section 2.2.2.5 requires impoundments and drainage channels for flammable liquid containment to conform to NFPA 30, Flammable and Combustible Liquids Code.
- NFPA 59A Section 2.2.3.2 requires provisions to minimize the damaging effects of fire from reaching beyond a property line, and requires provisions to prevent a radiant heat flux level of 1,600 BTU/ft^2-hr from reaching beyond a property line that can be built upon. The distance to this flux level is to be calculated with LNGFIRE or using models that have been validated

by experimental test data appropriate for the hazard to be evaluated and that are acceptable to USDOT.

- NFPA 59A Section 2.2.3.4 requires provisions to minimize the possibility of any flammable mixture of vapors from a design spill from reaching a property line that can be built upon and that would result in a distinct hazard. Determination of the distance that the flammable vapors extend is to be determined with DEGADIS or alternative models that take into account physical factors influencing LNG vapor dispersion. Alternative models must have been validated by experimental test data appropriate for the hazard to be evaluated and must be acceptable to USDOT. Section 2.2.3.5 requires the design spill for impounding areas serving vaporization and process areas to be based on the flow from any single accidental leakage source.

For the following liquefaction facilities that are proposed for this Project, FERC staff identified that the siting requirements from Part 193 and NFPA 59A would be applicable to the following equipment:

- Three 71,000-gallon ethylene storage tanks and associated process piping; and
- Two 176,000-gallon propane storage tanks and associated pumps and process piping.

2.8.5 Siting Analysis

Impoundment Sizing

When the USDOT incorporated NFPA 59A into the Part 193 regulations, the language defining required impoundment capacity for process areas was altered. Prior to the incorporation of NFPA 59A in 2000, the design spill in Part 193 assumed the full rupture of "a single transfer pipe which has the greatest overall flow capacity" for not less than 10 minutes (old Part 193.2059(d)). Under NFPA 59A Section 2.2.2.2 (2001 edition), the capacity of impounding areas for vaporization, process, or LNG transfer areas must equal the greatest volume that can be discharged during a 10-minute period from any single accidental leakage source or during a shorter time period based upon demonstrable surveillance and shutdown provisions acceptable to the USDOT. To ensure that impoundments are sized for a catastrophic failure, FERC staff requires impoundments to be sized based on the greatest flow capacity from a single transfer pipe for 10 minutes, while recognizing that different spill scenarios may be appropriate to calculate exclusion zones.

Sabine Pass proposes to install one 41,600-gallon storage tank to store make-up amine. An amine truck offloading area consisting of a truck-loading manifold would also be installed adjacent to the amine storage tank to receive deliveries of make-up amine for the acid gas removal system. The amine storage tank would be installed within a 4-foot-high diked area to contain any potential amine spills, which would either be recycled for reuse or disposed of safely. The volumetric capacity of the containment dike would be approximately 70,372 gallons, which would hold the entire contents of the amine storage tank.

Sabine Pass proposes a 75-foot-diameter by 11-foot-deep impoundment sump (Liquefaction Impoundment Sump) to serve the entire liquefaction process area. LNG transfer piping would be installed in elevated pipe racks. Potential spills occurring from transfer piping in the liquefaction facilities would be drained from underneath the elevated pipe racks toward concrete troughs and directed to the Liquefaction Impoundment Sump. The spill containment troughs would enter the sump below grade to ensure there would be adequate sloping for a spill to gravity drain into the sump. In addition, any potential spills from the refrigerant transfer piping between the refrigerant storage system and the liquefaction facilities would be captured by spill containment troughs and directed to the Liquefaction Impoundment Sump. Sabine Pass proposes to construct the refrigerant storage tanks, associated piping, and truck offloading stations within a concrete-paved area that would be sloped by a minimum of 1%, per NFPA 30, to direct any spills into the spill containment troughs. Potential spills would be directed away from the refrigerant storage tanks, piping, and truck offloading stations and into troughs leading to the Liquefaction Impoundment Sump.

The Liquefaction Impoundment Sump would have a total volumetric capacity of 363,527 gallons, with a net volumetric capacity of 134,649 gallons before backflowing into the troughs. Sabine Pass designed the Liquefaction Impoundment Sump to completely contain a 10-minute spill from a full rupture of the 24-inch-diameter LNG transfer common header without backflowing into the trough. However, FERC staff identified a 10-minute spill from a 48-inch-diameter LNG line in the LNG liquefaction train that would result in a spill volume of 182,000 gallons. The Liquefaction Impoundment Sump would be able to contain this spill volume, but would backflow into the troughs. Sabine Pass also evaluated a 10-minute spill from a full rupture of the ethylene line that extends from the refrigerant storage area to the liquefaction facilities. However, FERC staff identified a 10-minute spill from a 24-inch-diameter ethylene line in the LNG liquefaction train that would result in a spill volume of 92,630 gallons. The Liquefaction Impoundment Sump would be able to contain this spill volume without backflow into the troughs. The Liquefaction Impoundment Sump would also be able to contain a spill of the entire contents from the three 71,000-gallon ethylene storage tanks (213,000 gallons total), but would backflow into the troughs. Due to the storage and process conditions of the propane, propane releases would not result in substantial liquid accumulation compared to LNG or ethylene. Therefore, FERC staff agrees that the proposed impoundment system would be properly sized to contain the greatest volume of LNG or flammable refrigerant that can be discharged into this impoundment system from the full rupture of a single transfer pipe during a 10-minute period.

Table 2.8-2 lists the impoundment sizes for the Project.

Table 2.8-2
Impoundment Areas

Source	Spill Size (gallons)	Impoundment System	Impoundment Size (gallons)
Amine storage tank	41,600	Amine Impoundment Area	70,372
48-inch-diameter LNG line in the LNG liquefaction trains	182,000	Liquefaction Impoundment Sump	363,527
24-inch-diameter ethylene transfer line in the LNG liquefaction trains	92,630	Liquefaction Impoundment Sump	363,527
Ethylene storage vessels	213,000	Liquefaction Impoundment Sump	363,527

The existing Process Area Impoundment Sump, which would still be expected to capture spills from the 30-inch diameter interconnection piping, was constructed under docket CP04-47-000 and has a volumetric capacity of 528,760 gallons. However, Sabine Pass proposes to replace ten of the existing fifteen 4,304 gpm in-tank pumps in the LNG storage tanks with larger capacity 7,045 gpm pumps. Sabine Pass stated that the replacement of these pumps would allow fewer pumps to be operated to achieve the 52,834 gpm (12,000 m^3/hr) ship loading rate and the 4 Bscfd facility send-out rate. In addition, the increased capacity pumps would allow for redundancy and increased efficiency of the process. To ensure the operating constraints would limit the unloading/loading and send-out rates, **we recommend that:**

- **Prior to construction of the final design, Sabine Pass should file with the Secretary, for review and written approval by the Director of OEP, operating procedures that specify the loading rate would not exceed 12,000 m^3/hr. This information should be filed a minimum of 30 days before approval to proceed is requested.**

Design Spills

Design spills are used to determine the thermal radiation and vapor dispersion distances. As discussed in the previous section on impoundment sizing, prior to the incorporation of NFPA 59A in 2000, the design spill in Part 193 assumed the rupture of a single transfer pipe, with the greatest overall flow capacity. With the adoption of NFPA 59A, the basis for the design spill for impounding areas serving only vaporization, process, or LNG transfer areas became the flow from any single accidental leakage source.

As NFPA 59A (2001 edition) does not define a "single accidental leakage source", FERC staff sent a letter to the USDOT on April 19, 2005, requesting concurrence on the procedures for determining a single accidental leakage source. In giving recognition to the integrity of all-welded transfer piping, FERC staff based the determination of the single accidental leakage source on an evaluation of all small diameter attachments to the transfer piping for instrumentation, pressure relief, recirculation, etc., and any flanges that may be used at valves or other equipment, in order to determine the largest spill rate. The USDOT affirmed this approach in a May 6, 2005, letter to FERC.

However, this approach does not provide any quantitative justification for the selection of the design spill to be used in Part 193 exclusion zone calculations. A wide variety of single accidental leakage sources, ranging from packing and flange leaks to full guillotine ruptures of ship unloading lines, have been proposed in applications before the FERC. To achieve a consistent approach, FERC staff used generic failure rates to establish a more quantitative threshold for an acceptable minimum single accidental leakage source.

For storage tanks with over the top fill and no penetrations below the liquid level, Part 193, through adopted portions of NFPA 59A (2001 edition), defines the design spill as the largest flow from any single line that could be pumped into the impounding area with the container withdrawal pumps delivering the full-rated capacity. Based on published failure rates for LNG facilities (Pelto, Baker, et al.), the rupture of a storage tank outlet line is on the order of one failure every 20,000 to 30,000 years ($5x10^{-5}$ to $3x10^{-5}$ failures per year). Because this failure rate applies to a design spill that is specified by Part 193, FERC staff used this rate to determine appropriate single accidental leakage sources for impounding areas serving liquefaction process and transfer areas. Table 2.8-3 provides types of failures and associated failure rates:

Selecting a design spill based on equipment of failure rates equivalent to the failure specified by Part 193 for storage tanks provides a consistent basis for design spills to be used in demonstrating Part 193 compliance. Based on the piping failure rates above, FERC staff has determined the following single accidental leakage sources are necessary to show compliance with 49 CFR 193: 1) a full rupture of piping and connections less than or equal to 6 inches in diameter at any point along the line; and 2) a 2-inch-diameter hole in piping greater than 6 inches in diameter at any point along the line. USDOT has concurred with these criteria.

Table 2.8-3 Failure Rates	
Type of Failure	**Failure Rates (failure per year)**
Holes with an effective diameter of 0.40 inches (10 mm) in process vessels and storage tanks	$1x10^{-4}$ to $1x10^{-5}$
Leaks and ruptures of truck transfer hoses and ship transfer arms	$2x10^{-3}$ to $1x10^{-5}$
Ruptures at flanges and expansion joints	$4x10^{-2}$ to $8x10^{-4}$
Failures of gaskets	$3x10^{-2}$ to $4x10^{-3}$
Full rupture of piping 6 inches in diameter or less	$1.8x10^{-3}$ to $1x10^{-7}$
2-inch-diameter holes in piping more than 6 inches in diameter	$5x10^{-5}$ to $6x10^{-8}$

Process conditions at failures would affect the resulting vapor dispersion distances. In determining the spill conditions for these leakage sources, process flow diagrams for the proposed design, used in conjunction with the heat and material balance information (i.e., flow, temperature, and pressure), can be used to estimate the flow rates and process conditions at the location of the spill. In general, higher flow rates would result in larger spills and longer dispersion distances; higher temperatures would result in higher rates of flashing; and higher pressures would result in higher rates of jetting and aerosol formation. Therefore, two scenarios should be considered for each design spill:

(1) The pressure in the line is assumed to be maintained by pumps and/or hydrostatic head to produce the highest rate of flashing and jetting; and

(2) The pressure in the line is assumed to be depressurized by the breach and/or emergency shutdowns to produce the highest rate of liquid flow within a curbed, trenched, or impounded area.

Alternatively, a single scenario could be selected if it is adequately supported with an assessment of the depressurization calculations and/or an analysis of process instrumentation and shutdown logic acceptable to USDOT. In addition, the location and orientation of the leakage source must be considered, because the closer the leakage source is to the property line, the higher the likelihood that the vapor cloud would extend off-site.

NFPA 59A Table 2.2.3.5, as adopted by 49 CFR 193, requires the design spill duration to be 10 minutes, unless a shorter time, based on demonstrable surveillance and shutdown provisions, is acceptable to the USDOT. Isolation of the line may result in shorter durations and/or smaller inventory volumes, which may reduce the vapor dispersion distance. Safety instrumented systems, fire and gas systems, associated cause and effect matrices, and emergency shutdown valve closure times may be considered mitigating factors subject to USDOT approval.

In order to address the highest rate of LNG liquid flow, Sabine Pass specified a design spill for the liquefaction area impoundment using a full guillotine rupture of the 24-inch-diameter LNG transfer common header from the liquefaction trains to the LNG storage tanks. This liquid spill would be equal to a maximum flow rate of 13,208 gallons per minute (3,000 m^3/hr) and the spill duration was assumed to be 10 minutes. Sabine Pass considered three liquid spill locations along the trench: 1) northern end of Train 4 liquefaction trench, 2) western end of the common trench, and 3) the liquefaction sump. Based on our consultation with the USDOT, we believe that this design spill selection is consistent with the requirements of Part 193.

In order to address the highest rate of LNG flashing and jetting from high pressure piping, Sabine Pass specified a leak scenario as the full rupture of a pressurized 4-inch-diameter piping connection to a 30-inch-diameter pipe as their design spill. The characteristics used for the flashing and jetting release were a piping pressure of 60 psig, fluid temperature of -245.5°F, leak diameter of 4 inches, mass flow rate of 12,400 lb/min, and release direction of horizontal. The scenarios considered assumed a constant LNG release rate for a duration of 10 minutes at constant flow rate. Two flashing and jetting locations for the analysis were considered: 1) LNG piping in the Train 4 area and 2) LNG piping in the Train 2 area. The leak was assumed to occur approximately 15 feet above grade. Based on our consultation with the USDOT, we believe that this design spill selection is consistent with the requirements of Part 193.

As discussed in the Sabine Pass LNG and Pipeline Project Final Environmental Impact Statement, Docket CP04-47-000 (Sabine Pass FEIS), the design spill for the existing Process Area Impoundment Sump was based on the full guillotine rupture of the 30-inch diameter unloading line connecting the unloading arms on the jetty to the LNG storage tanks. The corresponding flow rate Sabine Pass used was the full unloading rate of 52,834 gpm (12,000 m^3/hr). Sabine Pass also evaluated a rupture of the 30-inch diameter interconnection line from the LNG storage tanks to the vaporizers. The flow capacity selected for the 30-inch diameter interconnection line from the LNG storage tanks was based on the combined flow from the existing nine 4,304 gpm in-tank pumps providing the 4 Bcfd sendout, which equated to approximately 38,745 gpm (8,800 m^3/hr). However, Sabine Pass selected the larger flow of 52,834 gpm (12,000 m^3/hr) from the unloading line as the design spill for the existing Process Area Impoundment Sump.

For this Project, Sabine Pass proposes to increase the flow capacity of 10 of the existing 15 in-tank pumps from 4,304 gpm to 7,045 gpm. Sabine Pass stated that although the existing pumps would be replaced with higher capacity pumps, fewer of the pumps would be run in order to obtain the 52,834 gpm (12,000 m^3/hr) ship loading rate. Sabine Pass further concluded that the related design spill and hazard analyses for the terminal would remain the same and would not impact the vapor dispersion exclusion zones for the existing facilities. The design spill criteria for the LNG storage tanks, which is the flow rate from a single container with all three pumps considered to be delivering the full rated capacity, would produce a lower design spill rate evaluated in the original Sabine Pass FEIS. Based on our consultation with the USDOT, we agree that no further analysis is needed. However, the siting calculations would need to be re-evaluated if a fourth pump were installed in the future.

For the propane and ethylene releases, Sabine Pass evaluated the facility's process piping design using the recommended failure rate criteria and process conditions. Based on the evaluation, Sabine Pass determined a full rupture of a pressurized 3-inch-diameter propane line and a full rupture of a pressurized 4-inch-diameter ethylene line would provide the most conservative design spills. However, Sabine Pass only considered flashing and jetting and did not consider liquid releases. Due to the temperature and pressure conditions under which propane would be handled on-site, a release would result in jetting and flashing without liquid accumulation. In addition, Sabine Pass has stated that a 10-minute spill from the 4-inch-diameter ethylene line would result in jetting and flashing without any liquid accumulation. Sabine Pass determined that this design spill would result in a 4.7% loss of volume in the ethylene system. Sabine Pass states that the system's pressure building coil would be able to maintain the pressure of the system with this small loss of volume. This preliminary analysis indicates that the liquid bounding case would most likely not occur. However, based on our consultation with USDOT, we believe the liquid bounding case should be evaluated. Therefore, **we recommend that:**

- **Sabine Pass should file with the Secretary, for review and approval by the Director of OEP, a vapor dispersion analysis from a liquid ethylene design spill <u>prior to initial site preparation</u>.**

Table 2.8-4 lists the characteristics used for the propane and ethylene flashing and jetting releases.

Table 2.8-4
Design Spill Parameters for Propane and Ethylene Flashing/Jetting Releases

Parameter	Propane	Ethylene
Leak Diameter (inches)	3	4
Pressure (psig)	233.5	280.3
Temperature (°F)	68.5	-24.8
Mass flow rate (lb/min)	16,100	31,200
Leak direction	Horizontal	Horizontal
Leak elevation	76.5	25

The scenarios considered assumed constant propane and ethylene release rates for a duration of 10 minutes at constant flow rate. Two flashing and jetting locations for each refrigerant analysis were considered: 1) refrigerant piping in the Train 4 area; and 2) refrigerant piping in the Train 2 area. Based on our consultation with the USDOT, we believe that this design spill selection is consistent with the requirements of Part 193.

Thermal Radiation Analysis

An LNG pool fire could cause high levels of thermal radiation (i.e., heat from a fire) if a large quantity of LNG spills in the presence of an ignition source. Section 2.2.3.2 of NFPA 59A, as incorporated in 49 CFR 193, requires the use of the LNGFIREIII computer program model developed by the Gas Research Institute to determine the extent of the thermal radiation distances. Alternatively, a different model may be used subject to the approval of the USDOT. NFPA 59A also establishes certain atmospheric conditions (0 mph wind speed, 70°F, and 50 percent relative humidity), which are to be used in calculating the distances. However, section 193.2057 supersedes these requirements and stipulates that the wind speed, ambient temperature, and relative humidity that produce the maximum exclusion distances must be used, except for conditions that occur less than 5 percent of the time based on recorded data for the area.

For an LNG fire within the Liquefaction Impoundment Sump, the exclusion distance at a level of 1,600 Btu/ft^2-hr was calculated using LNGFIREIII. For its analysis, Sabine Pass used meteorological data provided in "Climatology of the United States No. 20 Monthly Station Climate Summaries" for the station at Port Arthur Airport in Beaumont, Texas, from a period between 1973 and 1996. Although the weather data Sabine Pass used is not the most current, FERC staff believes that the data covers a sufficient time period and is a reasonable representation of the weather data for the area.

Sabine Pass selected the following ambient conditions to produce the maximum thermal radiation distances from the Liquefaction Impoundment Sump: wind speed of 27.6 mph, ambient temperature of 34°F, and 80 percent relative humidity. These conditions yield longer distances than the 0 mph wind speed, 70°F ambient temperature, and 50 percent relative humidity specified in NFPA 59A. However, FERC staff performed a thermal exclusion zone analysis for this sump using meteorological data that produced a longer exclusion zone distance for the incident flux at a level of 1,600 Btu/ft^2-hr. FERC staff used a wind speed of 17.4 mph, ambient temperature of 48.8°F, and 53 percent relative humidity to determine that the 1,600-Btu/ft^2-hr zone would extend 347 feet from the center of the sump. This

1,600-Btu/ft^2-hr exclusion zone would not extend beyond the property line as required by 49 CFR §193.2057.

Although LNGFIREIII is specifically designed to calculate thermal radiation flux levels for LNG pool fires, Sabine Pass provided justification that LNGFIREIII could also be used to conservatively calculate the thermal radiation flux levels for flammable hydrocarbons such as ethylene and propane. One of the parameters used by LNGFIREIII to calculate the thermal radiation flux is the surface emissive power (SEP) of the flame, which is an average value of the thermal radiation flux emitted by the fire. The SEP of an ethylene or propane fire is less than an equally sized LNG fire. Since the thermal radiation from a pool fire is directly proportional to the SEP, Sabine Pass determined that the thermal radiation exclusion zone distances required for ethylene and propane fires in the Liquefaction Impoundment Sump would not extend as far as the exclusion zone distance previously calculated for an LNG fire in the same sump. The thermal radiation distances to 1,600 Btu/ft^2-hr for propane and ethylene fires in the Liquefaction Impoundment Sump would not extend beyond the LNG exclusion zone. Based on our consultation with the USDOT, we believe that use of LNGFIREIII for calculating thermal radiation from refrigerants is consistent with the requirements of Part 193.

Vapor Dispersion Analysis

A large quantity of LNG spilled without ignition would form a flammable vapor cloud that would travel with the prevailing wind until it either dispersed below the flammable limit or encountered an ignition source. Sections 2.2.3.3 and 2.2.3.4 of NFPA 59A (2001 edition) and 49 CFR §193.2059 require provisions be made to minimize the possibility of flammable vapors reaching a property line that can be built upon and that would result in a distinct hazard. Title 49 CFR §193.2059 requires that dispersion distances be calculated for a 2.5 percent average gas concentration (one-half the LFL of LNG vapor) under meteorological conditions which result in the longest downwind distances at least 90 percent of the time. Alternatively, maximum downwind distances may be estimated for stability Class F, a wind speed of 4.5 mph, 50 percent relative humidity, and the average regional temperature.

The regulations in Part 193 specifically approve the use of two models for performing these dispersion calculations, DEGADIS and FEM3A, but also allow the use of alternative models approved by the USDOT. Although Part 193 does not require the use of a particular source term model, modeling of the spill and resulting vapor production is necessary prior to the use of vapor dispersion models. In the past, applicants have typically used the SOURCE5 program to model the vapor production from an LNG spill.

On July 7 and 16, 2010, the USDOT issued written interpretations in response to two requests regarding the regulations under 49 CFR 193.[6] Specifically, these requests sought clarification on whether § 193.2059 allowed the use of the SOURCE5 source term model and whether § 193.2059 required the effects of jetting and flashing to be considered in vapor dispersion exclusion zone calculations. In these interpretations, the USDOT stated that:

- SOURCE5 could no longer be used to determine the vapor gas exclusion zone for compliance with § 193.2059 unless the deficiencies identified in the Fire Protection Research Foundation's reports "Evaluating Vapor Dispersion Models for Safety Analysis of LNG Facilities Research Project (Apr. 2007)" and "LNG Source Term Models for Hazard Analysis: A Review of the State-of-the-Art and an Approach to Model Assessment (Mar. 2009)" had been addressed;

[6] PHMSA Interpretation "Re: Request for Written Interpretation on the Applicability of 49 CFR 193 to Proposed Waterfront Liquefied Natural Gas Plant in the City of Fall River, Massachusetts" (July 7, 2010) and PHMSA Interpretation "Re: Request for Written Interpretation on the Applicability of 49 CFR 193 to Proposed LNG Import Terminal in Robbinston, Maine" (July 16, 2010).

- the effects of jetting and flashing must be considered in order to comply with § 193.2059; and
- source term models must have a credible scientific basis and must not ignore phenomena which can influence the discharge, vaporization, and conveyance of LNG.

As a result of these interpretations, alternative dispersion models became necessary in order to examine the effects of jetting, flashing, and the conveyance of LNG for exclusion zone calculations. In August 2010, the USDOT issued Advisory Bulletin ADB-10-07 (Advisory Bulletin) to provide guidance on obtaining approval of alternative vapor-gas dispersion models under Subpart B of 49 CFR Part 193. On October 25, 2010, Det Norske Veritas submitted a petition for approval of PHAST-UDM Version 6.6 vapor gas dispersion model. In addition, on October 27 and December 22, 2010, GexCon submitted a petition for approval of its FLACS Version 9.1 Release 2 vapor gas dispersion model. On October 7, 2011, the USDOT issued separate Final Decisions approving the use of both of these models for vapor dispersion exclusion zone calculations.

In performing the vapor dispersion analysis required by 49 CFR §193.2059, Sabine Pass has submitted LNG vapor dispersion modeling using the FLACS computer model (version 9.1, release 2). FLACS includes a separate jetting and flashing model and a built-in source term model based on the two-dimensional shallow water equations to calculate the spreading and vaporization of an LNG pool on a substrate (concrete, soil, water, etc.). In a letter issued May 4, 2011, FERC staff requested Sabine Pass to seek approval from the USDOT on the source term. On May 24, 2011, Sabine Pass responded that FLACS includes a built-in source term model and that the FLACS computer model was currently under review by the USDOT. However, the October 7, 2011, USDOT Final Decision on FLACS did not approve the source term models because it requires a scenario specific review. Based on our consultation with the USDOT, we believe that the use of the FLASH utility model for flashing and jetting and the built-in source term model for pool spread and vaporization is suitable and complies with the siting requirements of Part 193. This determination is project specific and would need to be revisited for future applications of these source models.

As discussed in the Design Spills section, Sabine Pass selected various release scenarios for the liquid release and for the flashing and jetting release. For all the release scenarios, Sabine Pass used the following conditions, corresponding to 49 CFR §193.2059, for the vapor dispersion calculations: ambient temperature of 68.5°F, relative humidity of 50%, wind speed of 4.5 mph, atmospheric stability class of F and a ground surface roughness of 0.03 m. Sabine Pass accounted for the facility geometry, including the impoundment, trenches and liquefaction train geometry details as established by available plant layout drawings. Including the plant geometry would account for any wind channeling that could occur. The releases were initiated in the model simulations after 2 minutes to allow the wind profile to stabilize due to the presence of buildings and other obstructions. In addition, various wind directions and speeds were considered as part of a sensitivity analysis. Based on our consultation with the USDOT, we believe that these conditions are consistent with the requirements of Part 193.

For the 24-inch-diameter LNG piping liquid spill into the trenches and Liquefaction Impoundment Sump, Sabine Pass considered three locations: 1) northern end of trench in Train 4, 2) western end of the common trench between the Train 2 and Train 4, and 3) Liquefaction Impoundment Sump. For siting purposes, the region of most interest is the northwest corner of the proposed liquefaction facility (Train 4), where the facility comes closest to the property boundary.

According to Sabine Pass, LNG vapor dispersion results identified the need for a vapor barrier to be placed along a portion of the western boundary in order to prevent the LNG vapor from extending beyond the property line. The vapor barrier would consist of slats inserted in the site perimeter chain-link fence that would run along the property line. Sabine Pass considered this vapor barrier in LNG modeling simulations. In the cases listed above, the ½ LFL vapor cloud would remain within the Sabine Pass property as a result of the vapor fence. Based on our consultation with the USDOT, we believe the vapor dispersion analysis is consistent with the requirements of Part 193.

The maximum downwind distances for the three liquid spill locations are provided in Table 2.8-5 below.

Table 2.8-5
LNG Vapor Dispersion Scenarios from LNG Spills into Trenches and Sump

Scenario	Spill Location	Wind Speed (m/s)	Wind Direction	Approximate Downwind Distance to ½ LFL (feet)
1	Train 4	2	Northwest	525
2	Train 4	2	West	295
3	Train 2	2	Northwest	492
4	Train 2	1	West	558
5	Train 2	2	West	738
6	Train 2	3	West	738
7	Sump	2	Northwest	492
8	Sump	2	North	1,150
9	Sump	2	West	590

For LNG flashing and jetting from 4-inch diameter high pressure piping, Sabine Pass considered two locations: 1) near the pumps at the cold box of Train 2, and 2) near the pumps at the cold box of Train 4. For siting purposes, the regions of most interest are Train 2 and Train 4, where the facility comes closest to the property boundary. Table 2.8-6 below provides the results for each scenario.

Table 2.8-6
LNG Vapor Dispersion Scenarios from LNG Flashing and Jetting Releases

Scenario	Release Location	Wind Speed (m/s)	Wind Direction	Approximate Downwind Distance to ½ LFL (feet)
1	Train 2	2	Northwest	377
2	Train 2	2	West	738
3	Train 4	2	Northwest	377
4	Train 4	2	West	345

In all the LNG vapor dispersion scenarios for flashing and jetting, the ½ LFL vapor cloud would remain within the Sabine Pass property as a result of the vapor fence. Therefore, FERC staff believes the vapor dispersion analysis would meet the requirements of 49 CFR 193.2059.

Similar to the LNG release scenarios, Sabine Pass modeled propane and ethylene vapor dispersion distances using FLACS (version 9.1 release 2). FERC requested that Sabine Pass analyze the distance to a threshold value of ½ LFL to determine the potential impact on the public from propane and ethylene vapor dispersion. The ½ LFL value is consistent with Part 193.2057 and the safety factor of 2 recommended by the FLACS Final Decision issued by PHMSA.

For the propane flashing and jetting from 3-inch diameter high pressure piping, Sabine Pass considered two locations: 1) west of the switchgear building in Train 2, and 2) east of the switchgear building in Train 4. For siting purposes, the regions of most interest are Train 2 and Train 4, where the facility comes closest to the property boundary. Table 2.8-7 below provides the results for each scenario.

Table 2.8-7
Propane Vapor Dispersion Scenarios from Flashing and Jetting Releases

Scenario	Release	Wind speed (m/s)	Wind direction	Approximate downwind distance to ½ LFL (feet)
1	Train 2	2	Northwest	771
2	Train 2	2	West	870
3	Train 4	2	Northwest	427
4	Train 4	2	West	492
5	Train 4	2	West	492
6	Train 4	2	West	492

In all the propane vapor dispersion scenarios for flashing and jetting, the ½ LFL vapor cloud would remain within the Sabine Pass property as a result of the vapor fences. Therefore, FERC staff believes the vapor dispersion analysis would meet the requirements of 49 CFR 193.2059.

For the ethylene flashing and jetting from high pressure piping, Sabine Pass considered two locations: 1) west of the compressor shed in Train 2, and 2) east of the compressor shed in Train 4. For siting purposes, the regions of most interest are Train 2 and Train 4, where the facility comes closest to the property boundary. Table 2.8-8 below provides the results for each scenario.

Table 2.8-8
Ethylene Vapor Dispersion Scenarios from Flashing and Jetting Releases

Scenario	Release location	Wind speed (m/s)	Wind direction	Approximate downwind distance to ½ LFL (feet)
1	Train 2	2	Northwest	1,017
2	Train 2	2	West	919
3	Train 4	2	Northwest	705
4	Train 4	2	West	433

In all the ethylene vapor dispersion scenarios for flashing and jetting, the ½ LFL vapor cloud would remain within the Sabine Pass property as a result of the vapor fences. Based on our consultation with the USDOT, we believe the vapor dispersion analysis is consistent with the requirements of Part 193.

In all of the LNG and flammable refrigerant release scenarios, the vapor dispersion did not extend beyond the Sabine Pass property line. However, the vapor dispersion from the LNG and flammable refrigerants took into account the use of vapor barriers and air coolers. Sabine Pass stated that the vapor barriers would be routinely inspected by Sabine Pass personnel and repaired as necessary. In addition, security patrols would observe the vapor barriers during their regular rounds and report any observed damage. The air coolers would be required to operate during the liquefaction process and would not be included in the automatic emergency shutdown system. Based on our consultation with the USDOT, we believe the proposed mitigation measures are acceptable under Section 2.2.3.3 of NFPA 59A (2001 edition), as adopted in Part 193. However, in order to ensure that the vapor barriers are maintained properly, **we recommend that:**

- **<u>Prior to construction of the final design</u>, Sabine Pass should file with the Secretary, for review and written approval by the Director of OEP, procedures to maintain and inspect the vapor barriers provided to meet the siting provisions of 49 CFR §193.2059. This information should be filed a minimum of 30 days before approval to proceed is requested.**

Overpressure Considerations

The propensity of a vapor cloud to detonate or produce damaging overpressures is influenced by the reactivity of the material, the level of confinement and congestion surrounding the vapor cloud, and the flame travel distance. It is possible that the prevailing wind direction may cause the vapor cloud to travel into a partially confined or congested area. The primary flammable substances in the liquefaction area would be methane, propane, and ethylene. As adopted by Part 193, Section 2.1.1 of NFPA 59A (2001 edition) requires an evaluation of potential incidents and safety measures incorporated in the design or operation of the facility be considered. In order to address potential incidents related to overpressures associated with an LNG or refrigerant release, FERC staff requested that Sabine Pass analyze the distance to an overpressure threshold value of 1 psi to determine the potential impact on the public. The 1 psi value is used in consequence analyses required under federal regulations such as Title 40 CFR Part 68.22 and thus is considered a reasonable threshold for consequence analyses.

Sabine Pass modeled overpressures based on the proposed layout and pipe rack cross-sections of the liquefaction facilities using FLACS. Distances were determined with a safety factor of 2 (i.e., ½ psi), as a result of previous validation studies and peak-pressure averaging (Hansen, et al 2010).

As discussed in the Hazards section, unconfined LNG vapor clouds would not be expected to produce damaging overpressures given the LNG compositions handled onsite and the expected vapor dispersion characteristics. Therefore, damaging overpressures would not be expected to occur, and would not impact the public. For this reason, Sabine Pass did not model unconfined LNG releases in its overpressure analysis.

However, ignition of a confined vapor cloud could result in higher overpressures. An evaluation of the Sabine Pass facility indicates the only enclosed building within the liquefaction area would be the electrical switchgear building. In order to reduce the likelihood of flammable vapors dispersing into the electrical switchgear building, Sabine Pass proposes to pressurize the building, elevate the heating, ventilation, and air conditioning (HVAC) intake above the maximum height of any modeled flammable vapor cloud, and would install a flammable gas detector at the HVAC intake that would initiate an alarm and shutdown of the HVAC blower upon detection of 20% LFL gas concentrations. Based on our consultation with the USDOT, we believe the proposed mitigation measures are acceptable under Section 2.2.3.3 of NFPA 59A (2001 edition), as adopted in Part 193

Higher areas of congestion would also increase overpressures. For this reason, Sabine Pass modeled the ignition of the propane and ethylene in the most congested region of the facility. As discussed in the "Hazards" section, propane and ethylene have higher reactivity than methane and therefore ignition of these substances have a higher potential to result in damaging overpressures and pose a higher risk to the public. For this reason, Sabine Pass initially modeled overpressures generated from propane and ethylene vapor cloud ignitions. The results showed that ethylene produced the larger overpressures at the facility boundaries. Therefore, Sabine Pass only considered ethylene leak scenarios for its final overpressure analysis.

The time and location of ignition would also affect the overpressures generated. A time of ignition of 9 minutes was selected based on when the ignition of the flammable cloud would be expected to produce the worse-case scenario. Two ignition locations were evaluated. Table 2.8-9 below provides the distance to the ½ psi for each scenario modeled.

Table 2.8-9
Ethylene Overpressure Analysis Scenarios

Scenario	Description	Ignition Location	Approximate Distance to ½ psi (feet)
1	Ethylene Vapor Dispersion Scenario 3	Compressor Shelter	1,673
2	Ethylene Vapor Dispersion Scenario 3	Electrical Switchgear Building	1,821

In all the ethylene overpressure scenarios, the ½ psi would remain within the Sabine Pass property. Based on our consultation with the USDOT, we believe the overpressure analysis is consistent with Section 2.1.1 of NFPA 59A (2001 edition), as adopted in Part 193. However, overpressures greater than ½ psi would extend over the adjacent Kinder Morgan meter station. Sabine Pass has leased the area surrounding the Kinder Morgan meter station, and would require any ingress or egress from the meter station to be coordinated with Sabine Pass. To ensure adequate access control, **we recommend that:**

- **<u>Prior to initial site preparation</u>, Sabine Pass should file with the Secretary, for review and written approval by the Director of OEP, procedures for controlling access during construction and operation to the Kinder Morgan meter station. This information should be filed a minimum of 30 days before approval to proceed is requested.**

The overpressure analysis is based on the preliminary information contained in the FEED submitted by Sabine Pass. Piping and equipment arrangements may differ from final design, resulting in increased congestion or confinement in the liquefaction area and an increase in the overpressure distance. Therefore, **we recommend that:**

- **<u>Prior to construction of the final design</u>, Sabine Pass should file with the Secretary, for review and written approval by the Director of OEP, plant geometry models or drawings that verify the confinement and congestion represented in the front-end-engineering design of the liquefaction facilities or provide revised overpressure calculations indicating that a 1 psi overpressure would not impact the public. This information should be filed a minimum of 30 days before approval to proceed is requested.**

2.8.6 Emergency Response

Section 3A(e) of the NGA, added by Section 311 of the Energy Policy Act of 2005, stipulated that in any order authorizing an LNG terminal, the Commission shall require the LNG terminal operator to develop an ERP in consultation with the Coast Guard and state and local agencies. The ERP has been in place since the Sabine Pass LNG Terminal began operation in April of 2008. The existing ERP would need to be updated to include the proposed liquefaction facilities and emergencies related to refrigerant handling. Therefore, **we recommend that:**

- **Sabine Pass should update its ERP to include the liquefaction facilities as well as instructions to handle on-site refrigerant-related emergencies. The ERP should be filed with the Secretary for review and written approval by the Director of OEP <u>prior to initial site preparation</u>.**
- **The ERP should include a Cost-Sharing Plan identifying the mechanisms for funding all Project-specific security/emergency management costs that would be imposed on state and local agencies. In addition to the funding of direct transit-related security/emergency management costs, this comprehensive plan should include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. The Cost-Sharing Plan should be filed for review and written approval by the Director of OEP <u>prior to initial site preparation</u>.**

2.8.7 Facility Security

The security requirements for the Project are governed by 49 CFR 193, Subpart J - Security. This subpart includes requirements for conducting security inspections and patrols, liaison with local law enforcement officials, design and construction of protective enclosures, lighting, monitoring, alternative power sources, and warning signs. Requirements for maintaining safety of the liquefaction facility are in the Coast Guard regulations in 33 CFR 127. Requirements for maintaining security of the terminal are in 33 CFR 105.

In a letter to the Coast Guard dated June 17, 2010, Sabine Pass detailed the Liquefaction Project modifications and stated that no additional waterway impacts would result beyond the 400 ship transits already assumed in the February 2006 Waterway Suitability Assessment (WSA). In a letter dated June 24, 2010, the Coast Guard stated that a Letter of Intent (LOI) or a revision to the WSA is not required. However, the Coast Guard specified that applicable amendments to the Operations Manual, Emergency Manual, and Facility Security Plan (FSP) must be made that capture changes to the operations associated with the liquefaction Project. Sabine Pass must submit two copies of the Operations Manual and Emergency Manual to the Coast Guard Captain of the Port (COTP) for examination to meet 33 CFR 127.09. Additionally, the FSP must be submitted to the COTP for review and approval to meet 33 CFR 105.410.

2.8.8 LNG Vessel Safety

Marine safety and vessel maneuverability studies were submitted for the Sabine Pass LNG Terminal under FERC docket Nos. CP04-47-000 and CP05-396-000. There are no changes in the marine systems or the expected number of vessels; therefore, the risks associated are unchanged from the previously reviewed and approved analyses. Additionally, Sabine Pass has consulted with the COTP regarding the Liquefaction Project. The COTP issued a letter on June 24, 2010, stating: as the Project will not result in an increase in the size and/or frequency of LNG marine traffic on the Sabine Neches Waterway, neither submission of an LOI nor revision to the WSA is required.

2.9 Cumulative Impacts

Cumulative impacts may result when the environmental impacts associated with the Project are added to impacts associated with other projects in the past, present, or reasonably foreseeable future within the area affected by the Project. Cumulative impacts also may occur as a result of construction of multiple projects at the same time and in the same general location.

This cumulative impact analysis generally follows the methodology set forth in the Council on Environmental Quality's 2005 "Guidance on the Consideration of Past Actions in Cumulative Effects Analysis." Under those guidelines, inclusion of other projects within the analysis is based on identifying commonalities of impacts from other projects to potential impacts that would result from the Project. For an action to be included in the cumulative impact analysis, it must:

- Impact a resource area potentially affected by the Project;
- Cause this impact within all, or part of, the Project area; or
- Cause this impact within all, or part of, the time span for the potential impact from the Project.

For purposes of this cumulative analysis, only projects directly in the vicinity of the Project are considered. The effects of more distant projects are not assessed because their impact would be localized to their project areas and would not contribute significantly to the cumulative impact in the Project area.

The main ongoing project that potentially may cumulatively impact resources by construction and operation of the Project is the dredging of the Sabine-Neches Waterway and Sabine Pass Navigation Channel. The work consists of dredging approximately 6,000,000 cubic yards of maintenance material by pipeline dredge at Sabine-Neches Canal and Upper Reach Neches. The COE regularly conducts maintenance dredging in order to maintain the navigable channels at 42 feet and 40 feet basis mean lower low water level. This dredging is considered critical for Gulf Coast LNG terminals. Maintenance dredging of the SPLNG Terminal construction dock is not expected to affect ongoing dredging operations in the local area and should not contribute to any cumulative impacts in the immediate Project area.

The City of Port Arthur has planned construction of a 30-foot-diameter, 136 foot-high standpipe with associated infrastructure. This standpipe is being installed to supplement the residents of Port Arthur with potable water and fire protection needs. The standpipe, although not specifically constructed for this use, would also be used to supplement the potable water needs of the SPLNG facility. Cumulative impacts based on construction of this facility should prove to be insignificant. The standpipe will be constructed on an upland parcel in the Sabine Pass area of Port Arthur. An EA was completed in March 2011 and concluded that an environmental impact statement was not required given that the review showed a finding of no significant impact.

Stages 1 and 2 of the Project have been designed for construction and operation within the existing SPLNG Terminal property. These impacts would not result in significant expansion of the existing right-of-way, facilities, or access; or the current use of these components. Consequently, there would be no significant cumulative environmental impacts as a result of Project construction and operation.

Geology and Soils

As construction and operation of this Project would occur within the previously disturbed footprint of the existing SPLNG Terminal facility, Project activities in combination with other projects in the area would not have a cumulative effect on area geology and soils. All impact areas would occur within previously disturbed areas.

Water Resources

Under the Project, additional water would be required for operation of the SPLNG Terminal; however, no cumulative impacts would occur to the area's water resources as a result of additional projects in the area. The additional water would be supplied from an existing waterline as part of the Johnson Bayou Water District. In addition, a new redundant water line would be constructed to bring potable water from the City of Port Arthur. Also as mentioned above, dredging of Sabine-Neches Waterway and Sabine Pass Navigation Channel is presently ongoing and has the potential to affect water quality in the immediate areas. This is considered a temporary impact and would only occur during Project construction. Water quality will return to background following completion of dredging. In addition to maintenance dredging in the Sabine-Neches Waterway and Sabine Pass Navigation Channel, other maintenance dredging within the SPLNG marine terminal area would occur separately as part of the SPLNG Project. The maintenance dredging within the marine terminal would be confined to marine terminal slip areas. Impacts would only occur during Project construction and water quality would return to background levels following completion of dredging.

Cumulative wetland impacts could occur if more than one project were affecting the same wetland at the same location at the same time, where wetlands are permanently drained or filled, and where wetland characteristics and functionality are altered by construction and operational activities. The primary impact of construction and operation of the proposed facilities would be the temporary alteration and permanent loss of 136.28 acres of emergent wetlands within the former DMPA. However, there is no hydrologic connection to the surrounding watershed even though the wetlands are mapped within the Sabine Lake Watershed. Therefore, removal of these wetlands in addition to other ongoing projects in the area would not have a cumulative impact on the overall watershed.

Fisheries, Wildlife, and Vegetation

As construction and operation of the Project would occur within the previously disturbed footprint of the existing SPLNG Terminal facility, Project activities in combination with other projects in the area would not have a cumulative effect on area wildlife or vegetation, nor create additional fragmented habitat. The maintenance dredging associated with dock construction would occur in a previously disturbed area and would be in conjunction with ongoing dredging and maintenance activities performed by the COE. In addition to the on-site dredging associated with the Project, other maintenance dredging in the Sabine-Neches Waterway and Sabine Pass Navigation Channel is currently ongoing. Given the fact that the COE regularly conducts maintenance dredging in order to maintain the navigable channels at 42 feet and 40 feet basis mean lower low water level, this dredging is considered critical for Gulf Coast LNG terminals. Impacts would only occur during Project construction and water quality would return to background levels following completion of dredging. This activity should have little impact on marine resources as this is a temporary impact.

Land Use, Recreation, and Visual Resources

No cumulative impacts to recreational vessel traffic would occur because the construction and operation of the SPLNG facility would not increase the numbers of LNG ships or berthing facilities. In addition, as part of previous authorizations for the terminal, LNG carriers traveling to and from the SPLNG Terminal would use established, well-traveled shipping lanes, thus reducing the potential for collisions.

As construction and operation of Stages 1 and 2 would occur within the footprint of the existing SPLNG Terminal facility, cumulative impacts to ongoing land use and local recreational users (e.g., fishing, boating, and bird-watching) as a result of additional ongoing projects in the area would be negligible. The proposed construction would create a negligible visual cumulative impact as the area is already largely industrial.

Socioeconomics

Ongoing and pending construction projects in the area may result in an increased demand for housing and may have a minor affect if there is competition between construction personnel and tourists for hotel and motel rooms or campsites during peak tourist seasons. However, this impact is expected to be short-term and would not have a long-term cumulative impact on the socioeconomic conditions in the area.

Cultural Resources

As construction and operation of the Project would occur within the previously disturbed footprint of the existing SPLNG Terminal facility, Project activities in combination with other projects in the area would not have a cumulative effect on area cultural resources. All impact areas would occur within previously disturbed areas.

Air Quality and Noise

Air Emissions and fugitive dust from vehicle operation during the construction of the Project and any future projects, would possibly combine to result in cumulative impacts to air quality. Emissions from construction equipment would be primarily restricted to daylight hours and would be minimized through typical control equipment. The construction equipment emissions would result in short-term emissions that would be highly localized. Construction emissions are not expected to have a significant impact on air quality in the region.

As discussed in Section 2.7, detailed modeling was performed to quantitatively evaluate the impacts from operation of the Project and existing SPLNG facility. The modeling also included other existing sources of air emissions in the Project area. The results of the modeling analysis concluded that there would be no significant impact on air quality from operation of the Project in the region.

Climate Change

Climate change is the change in climate over time, whether due to natural variability or as a result of human activity, and cannot be represented by single annual events or individual anomalies. For example, a single large flood event or particularly hot summer is not an indication of climate change, while a series of floods or warm years that statistically change the average precipitation or temperature over years or decades may indicate climate change.

The Intergovernmental Panel on Climate Change (IPCC) is the leading international, multi-governmental scientific body for the assessment of climate change. The United States is a member of the IPCC and participates in the IPCC working groups to develop reports. The leading United States scientific body on climate change is the United States Global Change Research Program (USGCRP). Thirteen federal departments and agencies[7] participate in the USGCRP, which began as a presidential initiative in 1989 and was mandated by Congress in the Global Change Research Act of 1990.

The IPCC and USGCRP have recognized that:

- Globally, GHGs[8] have been accumulating in the atmosphere since the beginning of the industrial era (circa 1750);

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7 The following departments comprise the USGCRP: U.S. Environmental Protection Agency, Department of Energy, Department of Commerce, Department of Defense, Department of Agriculture, Department of the Interior, Department of State, Department of Transportation, Department of Health and Human Services, National Aeronautics and Space Administration, National Science Foundation, Smithsonian Institution, and Agency for International Development.

8 A discussion of greenhouse gases (GHG) can be found in Section 2.7

- Combustion of fossil fuels (coal, petroleum, and natural gas), combined with agriculture and clearing of forests is primarily responsible for the accumulation of GHG;
- The anthropogenic GHG emissions are the primary contributing factor to climate change; and
- Impacts extend beyond atmospheric climate change alone, and include changes to water resources, transportation, agriculture, ecosystems, and human health.

The USGCRP issued its recent report, *Global Climate Change Impacts in the Unites States*[9], in June 2009 summarizing the impacts climate change has already had on the United States and what projected impacts climate change may have in the future. The report includes a breakdown of overall impacts by resource and impacts described for various regions of the United States. Although climate change is a global concern, for this cumulative analysis, we will focus on the cumulative impacts of climate change in the Project area.

The *Global Climate Change Impacts in the United States* report notes the following continental Southeast and Coastal regional impacts:

- Average temperatures have risen about 2° Fahrenheit (F) since 1970 and are projected to increase another 4.5 to 9°F during this century;
- Increases in illness and death due to greater summer heat stress;
- Destructive potential of Atlantic hurricanes has increased since 1970 and the intensity (with higher peak wind speeds, rainfall intensity, and storm surge height and strength) is likely to increase during this century;
- In the United States, within the past century, relative sea level changes ranged from falling several inches to rising about 2 feet and are projected to increase another 3 to 4 feet this century;
- Sea level rise and human alterations have caused 1,900 square miles of coastal wetland loss in Louisiana during the past century, reducing their capacity to protect against storm surge, and projected sea level rise is anticipated to result in the loss of a large portion of the nation's remaining coastal wetlands;
- Declines in dissolved oxygen in streams and lakes have caused fish kills and loss of aquatic species diversity;
- Moderate to severe spring and summer drought areas have increased 12 to 14% (with frequency, duration and intensity also increasing also projected to increase);
- Longer periods of time between rainfall events may lead to declines in recharge of groundwater and decreased water availability;
- Responses to decreased water availability, such as increased groundwater pumping, may lead to stress or depletion of aquifers and strain on surface water sources;
- Increases in evaporation and plant water loss rates may alter the balance of runoff and groundwater recharge, which would likely to lead to saltwater intrusion into shallow aquifers; and
- Coastal waters have risen about 2°F in several regions and are likely to continue to warm as much as 4 to 8°F this century; and

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9 US Global Change Research Program; *Global Climate Change Impacts in the United States*, Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson, (eds.). Cambridge University Press, 2009.

- Coastal water warming may lead to the transport of invasive species through ballast water exchange during ship transit.

The GHG emissions associated with construction and operation of the Project were identified in Section 2.6. Emission of GHGs from the Project would not have any direct impacts on the environment in the Project area. The Project would contribute approximately 2% of Louisiana's GHG emissions. Sabine Pass included a GHG BACT analysis as part of its air permit application to LDEQ.

We received several comments during scoping expressing concerns about the amount of GHG emissions that would result from the liquefaction process. Sabine Pass provided information on the technical feasibility on using carbon capture and storage (CCS) at the facility in its GHG BACT analysis. CCS involves deploying a method to capture carbon from the exhaust stream and then finding a method for permanent storage (injecting the recovered CO_2 underground through various means, including enhanced oil recovery, saline aquifers, and un-mineable coal seams). In its GHG BACT analysis, Sabine Pass indicated that it could not commit to CCS because no CO_2 pipeline currently exists near the SPLNG Terminal. Sabine Pass stated it \should not be expected to contract with a single pipeline supplier because there are currently no market conditions to regulate the availability and associated cost of such pipelines. In addition, the Project would be located in a region that does not have any geological formations that support sequestration.

To further supplement its analysis, we asked Sabine Pass to analyze an alternative to capturing CO_2 and constructing a pipeline from the liquefaction facility to the nearest access point to the Denbury Green CO_2 pipeline under construction in Texas and Louisiana. One pipeline route would extend through an interconnect with the Denbury Green Pipeline at mainline valve-21, approximately 28.5 miles north of the SPLNG Terminal. To avoid impacts to the Sabine National Wildlife Refuge, Sabine Lake, and the metropolitan areas of Orange and Pinehurst, Texas, a constructible route to this point would be approximately 34 to 36 miles long. An alternative and more direct route, would be a pipeline directed northwest of the SPLNG Terminal. To avoid residential and industrial areas of Port Arthur, Texas, the route would be at least 22.5 miles in length, would require a crossing of the Sabine Pass Channel, and would be constructed on approximately 10 miles of marsh wetlands.

Using either pipeline alternative, Sabine Pass would need to install a compressor to increase the pressure from the exhaust stream (near atmospheric) to the pressure in the pipeline that Denbury Pipeline operates (approximately 1,600 psig). This alternative would result in additional environmental and air quality impacts.

However, Sabine Pass selected LM2500+G4 turbines over heavy duty Frame 5D turbines, which have a better thermal efficiency and reduced CO_2 emissions. In addition, all turbines would be operated using natural gas, which has the lowest carbon intensity of any fuel available for the turbines. Sabine Pass has also selected good combustion/operating practices (operating with water injection) as its BACT for CO_2 and CH_4 emissions from the turbines and has proposed BACT limits for CO_2, CH_4, and N_2O. Sabine Pass has selected CO_2 BACT limits for the acid gas removal unit vents as well. CO_2 emissions from flaring would be reduced through Sabine Pass' selection of flare gas recovery. BACT limits for the marine flare and wet and dry flares were also selected for CO_2 and CH_4. Sabine Pass also selected BACT limits for CO_2, CH_4, and N_2O for the natural gas-fired emergency generator engines. And finally, Sabine Pass has selected to employ the use of an optical gas imaging instrument for equipment leak detection for CH_4 BACT for fugitive emissions. Sabine Pass' design also includes a waste heat recovery system on each liquefaction train for regenerating the gas driers and amine system.

Currently there is no standard methodology to determine how the Project's incremental contribution to GHGs would translate into physical effects on the global environment. However, the emissions would increase the atmospheric concentration of GHGs, in combination with past and future emissions from all other sources, and contribute incrementally to climate change that produces the impacts previously described. Because we cannot determine the Project's incremental physical impacts due to climate change on the environment, we cannot determine whether the Project would result in significant impacts related to climate change.

3 Alternatives

In accordance with NEPA and Commission policy, we identified and evaluated alternatives to the Project to determine whether they would be reasonable and environmentally preferable to the proposed action. These alternatives include the no-action alternative, energy alternatives, system alternatives, and alternative site configurations. The evaluation criteria for selecting potentially reasonable and environmentally preferable alternatives include:

- Technical feasibility and practicality;
- Significant environmental advantage over the Project; and
- Ability to meet the Project objectives.

3.1 No-Action Alternative

The Commission has three possible courses of action in processing an application. It may (1) deny the proposal, (2) postpone action pending further study, or (3) authorize the proposal with or without conditions.

Under the no-action alternative, Sabine Pass would not construct the Project. If the proposed liquefaction facilities at the SPLNG Terminal were not constructed, neither the adverse impacts identified in this EA nor the beneficial impacts would occur. The no-action alternative could not meet the purpose and need for the Project. If the Project was not implemented, the LNG terminal located in Alaska would remain the only operational LNG export terminal, and the Project objective of increasing economic trade and ties with foreign nations would become limited because of the practical infeasibility of exporting LNG from Alaska to Atlantic Basin and European markets.

Also, if the Commission denies the proposal, the development of unconventional, particularly shale, gas-bearing formations in the U.S., may not be facilitated in a timely fashion. Similarly, the local economy would not be stimulated by job creation, increased economic activity, and tax revenues.

3.2 Alternative Energy Sources

The purpose of the Project is to export clean-burning natural gas to other countries in order to meet growing market demands because of the lower cost of natural gas compared to other energy sources. However, it was important to look at alternative fossil fuel energy sources, such as coal and oil, as part of the alternative selection process. Studies have shown that, when used to fire a power plant, natural gas emits approximately half the CO_2 emissions as compared to conventional plants that utilize other fossil fuels. The use of coal or oil may also significantly increase environmental impacts as a result of the Project. Similarly, natural gas has been termed a "bridge fuel" between the dominant fossil fuels used today and renewable energy sources because it is clean burning and can reliably serve as a backup fuel to renewable energy facilities, which often provide power intermittently. Therefore, natural gas was identified as the energy source that is most sensible, both economically and environmentally.

3.3 Alternative Systems

Alternative systems would replace all or part of the Project by making use of other existing natural gas export facilities, pipelines, or other methods of transporting natural gas. Sabine Pass looked at existing and planned LNG export facilities, including the Kenai LNG Plant, located in Alaska, which is the only LNG export facility currently operating in the United States. A proposed export facility near British Columbia, Canada, was also identified. Because the Project would provide an outlet for domestically produced natural gas from the Marcellus and Haynesville shale formations in Texas and

Louisiana, and would bring LNG to markets in Europe and other locations in the Atlantic Basin, both the Alaska and British Columbia facilities were deemed as non-viable alternative systems. Neither alternative system would be economically or practically feasible due to shipping distances as a result of their geographic locations and subsequently would not meet Project criteria.

Freeport has entered into the pre-filing process with the Commission for a project to add natural gas liquefaction facilities to its existing LNG import terminal on Quintana Island in Brazoria County, Texas, for exportation of domestic natural gas. Freeport indicates that its project would produce about 12.0 mtpa of LNG. This would allow Freeport to convert domestically produced natural gas to LNG for storage and export. Freeport LNG plans to commence construction in December 2012 and expects to be ready to commence LNG exports in late 2015. This project would be located in a similar geographic area and would meet many of the same Project objectives. Although the Project as proposed is designed to be of larger capacity, the Freeport LNG Liquefaction Project is considered a feasible alternative to the Sabine Pass Liquefaction Project. If FERC finds that these projects are environmentally acceptable, the Commission could approve none, all, or either of them, and allow the market to decide which facilities ultimately get built.

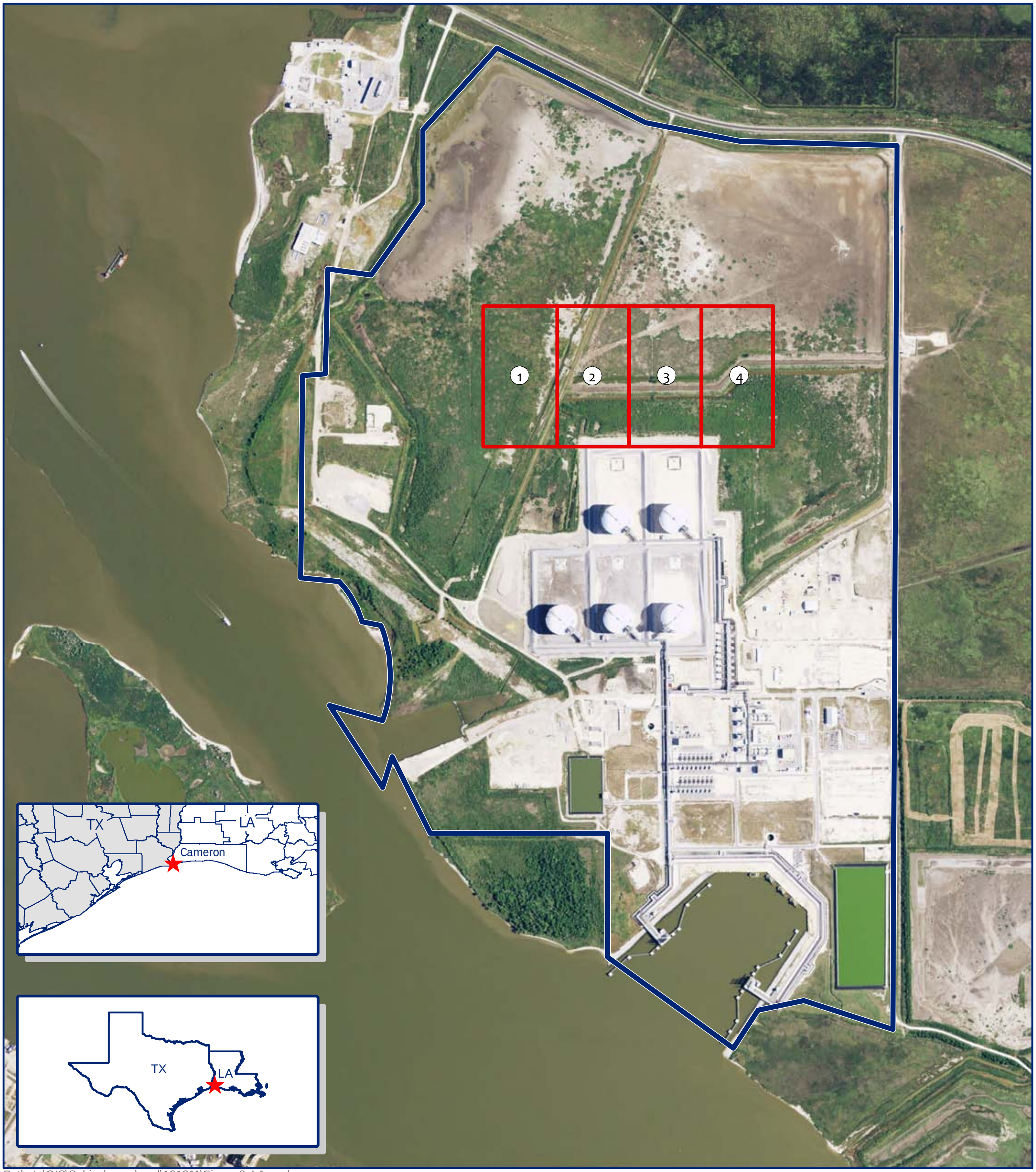
3.4 Alternative Configurations

Sabine Pass identified alternative configurations for the Project layout, including alternative layouts for the liquefaction facilities. Sabine Pass looked at alternative layouts (location and configuration of major Project components) and attempted to identify layouts that would minimize environmental impact while concurrently maximizing utilization, as discussed below. Specific environmental factors that were analyzed include location to noise sensitive areas, stormwater flow, soil stabilization, and wetland impacts. Other factors involved in evaluating the configurations include constructability (e.g., lay down areas, existing infrastructure, and transportation logistics), cooling air recirculation, and other pertinent safety criteria. These alternative configurations are illustrated on Figures 3.4-1 through 3.4-5.

3.4.1 Alternative 1

Alternative 1 includes all elements of the Proposed Action (new facilities and infrastructure); however, the site configuration would be slightly different. The total project area would encompass approximately 288.21 acres. Under Alternative 1, installation of all four liquefaction trains would occur north of the sixth LNG storage tank. This particular site plan would require the most significant soil stabilization of all of the alternatives and would not utilize any existing stabilized soils from the original Phase 1 or 2 SPLNG Terminal construction. Each of the four trains would be located in DMPA wetlands. Alternative 1 would impact a total of approximately 200.63 acres, including approximately 165.63 acres in Mitigation Areas C, D, and F and another approximately 35 acres of wetlands north of the LNG storage tanks, all subject to COE permitting requirements. This is significantly more than the proposed configuration wetland impact of 136.28 acres. The total site plan acreage would remain the same under this alternative as under the Proposed Action. Overall, no constructability issues have been identified with Alternative 1. However, because of the significant additional wetland impacts, FERC staff does not recommend the Alternative 1 site configuration.

Sabine Pass Liquefaction Project



Path: L:\GIS\Sabine\maps\mxd\101211\Figure 3.4-1.mxd

Figure 3.4-1
Alternative 1
Cameron Parish, Louisiana

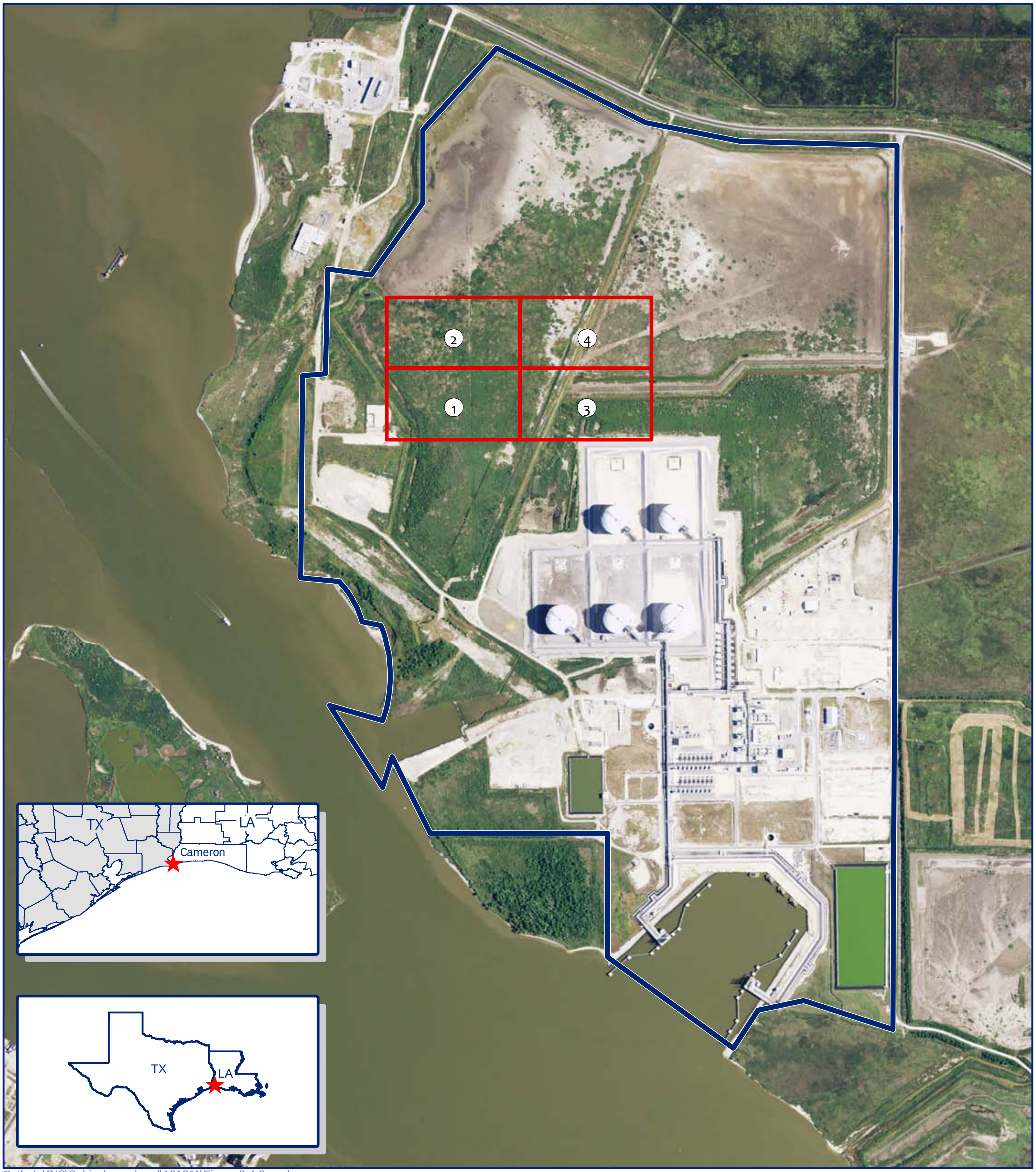
Key:

- Sabine Pass Terminal Boundary
- Train Area

N

0 1,000 2,000 Feet

Sabine Pass Liquefaction Project



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Key:

Sabine Pass Terminal Boundary

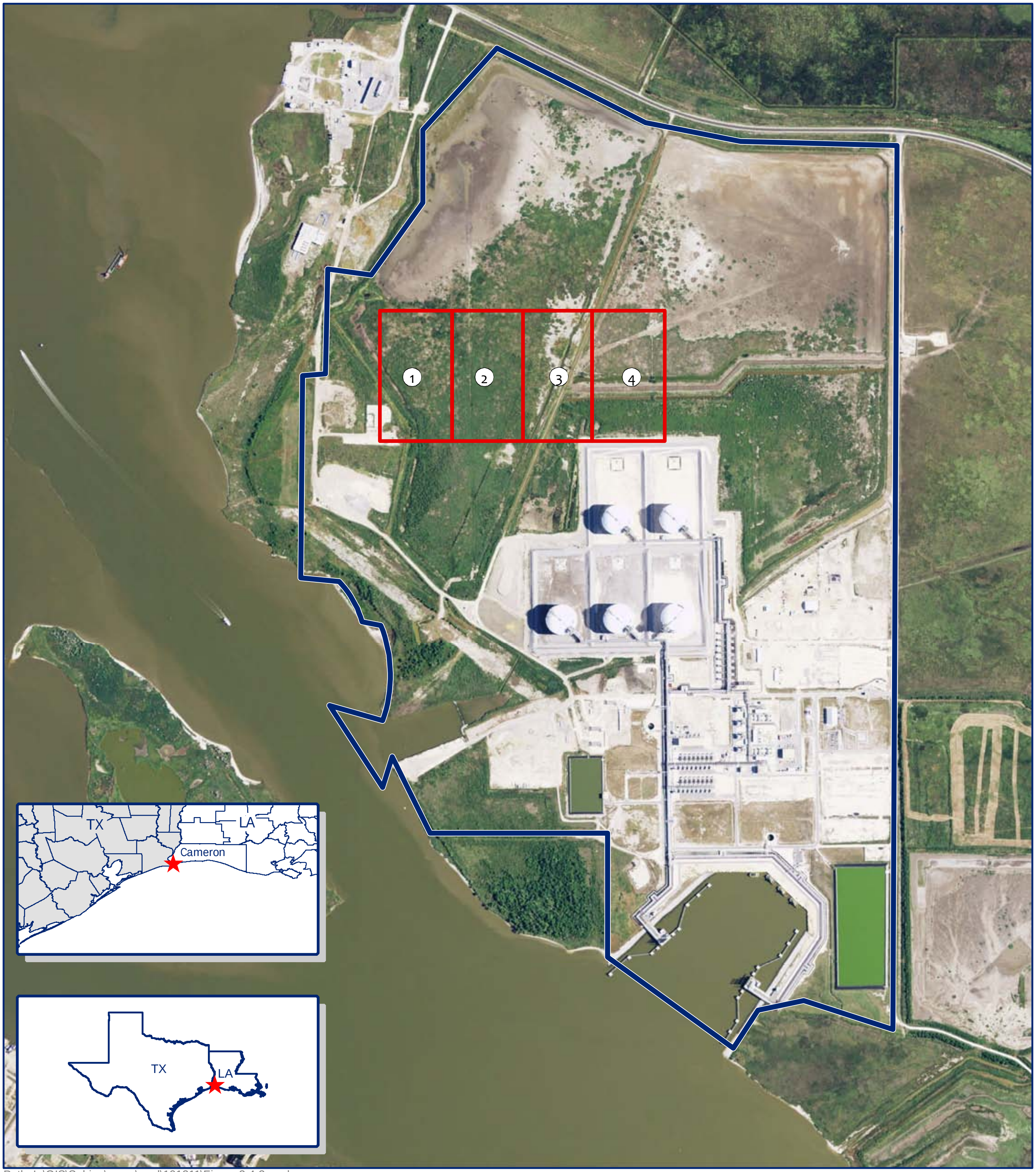
Train Area

Figure 3.4-2
Alternative 2
Cameron Parish, Louisiana

0 1,000 2,000 Feet

N

Sabine Pass Liquefaction Project



Path: L:\GIS\Sabine\maps\mxd\101211\Figure 3.4-3.mxd

Key:

Sabine Pass Terminal Boundary

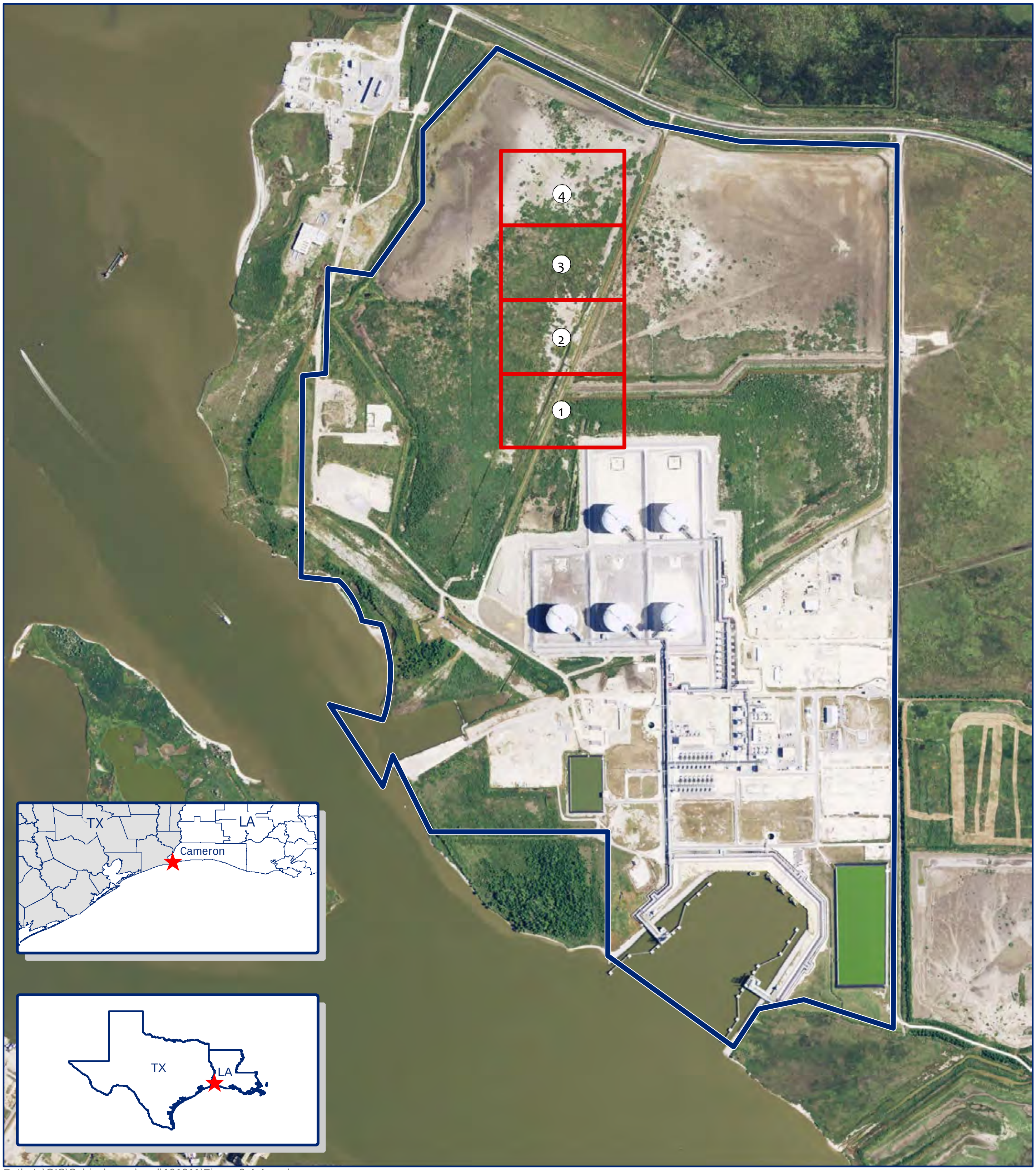
Train Area

Figure 3.4-3
Alternative 3
Cameron Parish, Louisiana

0 1,000 2,000 Feet

N

Sabine Pass Liquefaction Project



Path: L:\GIS\Sabine\maps\mxd\101211\Figure 3.4-4.mxd

Key:

Sabine Pass Terminal Boundary

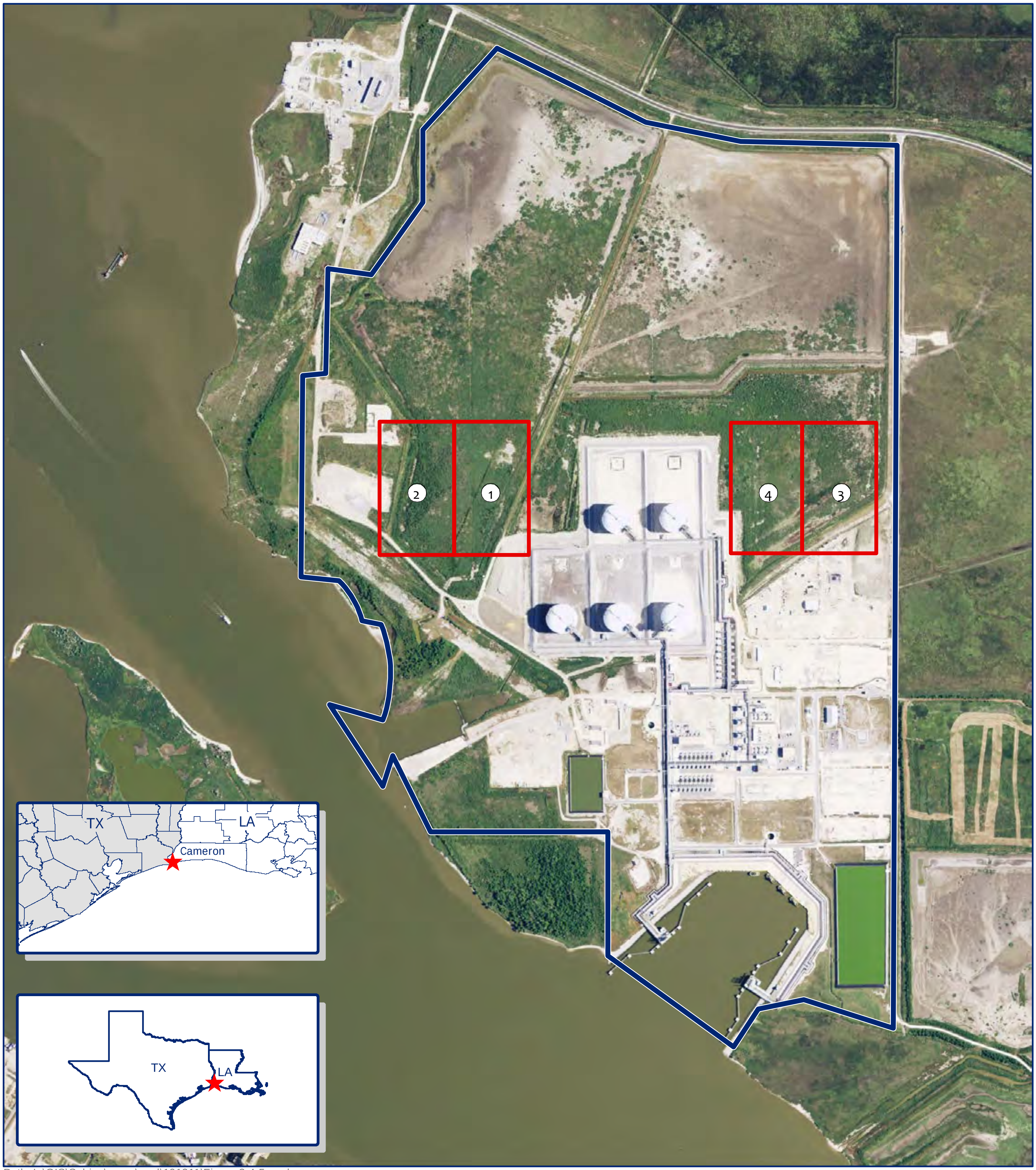
Train Area

N

Figure 3.4-4
Alternative 4
Cameron Parish, Louisiana

0 1,000 2,000 Feet

Sabine Pass Liquefaction Project



Path: L:\GIS\Sabine\maps\mxd\101211\Figure 3.4-5.mxd

Key:

Sabine Pass Terminal Boundary

Train Area

Figure 3.4-5
Alternative 5
Cameron Parish, Louisiana

0 1,000 2,000 Feet

N

3.4.2 Alternative 2

Alternative 2 includes the same elements as Alternative 1 (new facilities and infrastructure); however, the site configuration would be slightly different. Under Alternative 2, installation of two liquefaction trains would occur north and west of the sixth LNG storage tank, and the remaining two liquefaction trains would be installed east of these liquefaction trains and north of the sixth LNG storage tank. This site plan would also require soil stabilization similar to the Proposed Action. Current land use consists of approximately 165.38 acres in wetland Mitigation Areas C, D, and F and approximately 39 acres of wetland habitat north of the LNG tanks (totaling 204.38 acres of wetland impacts), all of which would be subject to COE permitting requirements. This is substantially more than the proposed configuration wetland impact acreage of 136.28. The total site plan acreage would remain the same under this alternative as under the Proposed Action. However, Sabine Pass has indicated there would be a constructability limitation for Tank 6. Also, based on this configuration, the existing LNG tanks' location would obstruct the prevailing wind and have a negative impact on the cooler efficiency. Because of the significant additional wetland impacts and the construction and operation limitations, FERC staff does not recommend the Alternative 2 site configuration.

3.4.3 Alternative 3

Alternative 3 includes the same elements as Alternative 1 (new facilities and infrastructure) and the installation of the liquefaction trains in the same locations as under Alternative 2; however, the trains would be oriented north-south instead of east-west. Alternative 3 would require the same total site plan acreage during both construction and operation activities as the Proposed Action. Additionally, the alternative site plan requires considerable amounts of soil stabilization. The existing land use for Alternative 3 includes approximately 142.97 acres in wetland Mitigation Areas C, D, and F and 38 acres in wetlands north of the LNG tanks (totaling 180.97 acres of wetland impacts), all of which would be subject to COE permitting requirements. The impacted wetland acreage under Alternative 3 is considerably more than the proposed alternative's wetland impact of 136.28 acres (approximately 113.98 acres of wetlands in Mitigation Areas C, D, and F and 22.30 acres of additional new wetland impacts). This alternative also results in a constructability limitation with for Tank 6. This Alternative does not provide an environmental benefit over the proposed configuration; therefore, FERC staff has eliminated it from further consideration.

3.4.4 Alternative 4

Alternative 4 includes the same elements as Alternative 1 (new facilities and infrastructure); however, the site configuration would be slightly different. As with Alternative 3, this plan also requires greater amounts of soil stabilization. Under Alternative 4, installation of all four liquefaction trains would occur north of the three LNG storage tanks. The existing land use includes 140.89 acres in wetland Mitigation Areas C, D, and F and 47 acres of wetlands north of the LNG tanks (totaling 187.89 acres of wetland impacts), all of which would be subject to COE permitting requirements. The impacted wetland acreage under Alternative 4 is considerably more than the proposed alternative's wetland impact of 136.28 acres. As with all alternatives previously discussed, Alternative 4 would occur within the existing SPLNG facility and the total site plan acreage would remain the same. This alternative would result in less desirable stormwater flow and would also cause a construction limitation on LNG Tank 6. Also, based on this alternative's configuration, the LNG tanks would obstruct the prevailing wind and have a negative impact on the cooler efficiency. This alternative does not provide an environmental benefit over the proposed configuration; therefore, FERC staff has eliminated it from further consideration.

3.4.5 Alternative 5

Alternative 5 includes the same elements as Alternative 1 (new facilities and infrastructure); however, the site configuration would be slightly different. Under Alternative 5, two liquefaction trains would be installed west of the three LNG storage tanks, and two liquefaction trains would be installed east of the three LNG storage tanks. As with all alternatives previously discussed, Alternative 5 would occur within the existing SPLNG facility and the total site plan acreage would remain the same. The site plan would require less soil stabilization than the previous alternatives by utilizing approximately 14 acres of stabilized soil from Phases 1 and 2. The remaining land use includes approximately 40.23 acres in wetland Mitigation Areas C, D, and F and approximately 134.71 acres of wetlands north of the LNG tanks (totaling 174.94 acres of wetland impacts), all of which would be subject to COE permitting requirements. This alternative represents greater impacts on regulated wetlands than the proposed alternative of 136.28 acres. Also, this alternative would require additional logistics for managing the transportation of heavy equipment during construction. The Alternative 5 configuration provides the best air recirculation from the process coolers. However, this alternative would require additional substations and impoundment trenching, and a lift station would be required for managing additional stormwater runoff. The split process train arrangement would create added difficulties during operations and maintenance of equipment. The benefits of this alternative are far outweighed by the added impacts; therefore, FERC staff has eliminated it from further consideration.

4 Staff's Conclusions and Recommendations

Based upon the analysis in this EA, we have determined that if Sabine Pass constructs and operates the facilities in accordance with its application, supplements, and staff's mitigation measures below, approval of this Project would not constitute a major federal action significantly affecting the quality of the human environment.

The staff recommends that the Commission Order contain a finding of no significant impact and include the measures listed below as conditions to the certificate the Commission may issue to Sabine Pass.

1. Sabine Pass shall follow the construction procedures and mitigation measures described in its application (and supplements, including responses to staff data requests) and as identified in the EA, unless modified by the Order. Sabine Pass must:
   a. request any modification to these procedures, measures, or conditions in a filing with the Secretary of the Commission (Secretary);
   b. justify each modification relative to site-specific conditions;
   c. explain how that modification provides an equal or greater level of environmental protection than the original measure; and
   d. receive approval in writing from the Director of OEP before using that modification.
2. The Director of OEP has delegated authority to take all steps necessary to ensure the protection of life, health, property and the environment during construction and operation of the project. This authority shall include:
   a. stop-work authority and authority to cease operation; and
   b. the design and implementation of any additional measures deemed necessary to assure continued compliance with the intent of the conditions of the Order.
3. **Prior to any construction**, Sabine Pass shall file an affirmative statement with the Secretary, certified by a senior company official, that all company personnel, environmental inspectors (EIs), and contractor personnel will be informed of the EI's authority and have been or will be trained on the implementation of the environmental mitigation measures appropriate to their jobs before becoming involved with construction and restoration activities.
4. The authorized facility locations shall be as shown in the EA. **As soon as they are available, and before the start of construction**, Sabine Pass shall file with the Secretary any revised detailed survey maps at a scale not smaller than 1:6,000 for all facilities approved by the Order. All requests for modifications of environmental conditions of the Order or site-specific clearances must be written and must reference locations designated on these maps.
5. Sabine Pass shall file with the Secretary detailed alignment maps/sheets and aerial photographs at a scale not smaller than 1:6,000 identifying all route realignments or facility relocations, and staging areas, pipe storage yards, new access roads, and other areas that would be used or disturbed and have not been previously identified in filings with the Secretary. Approval for each of these areas must be explicitly requested in writing. For each area, the request must include a description of the existing land use/cover type, documentation of landowner approval, whether any cultural resources or federally listed threatened or endangered species would be affected, and whether any other environmentally sensitive areas are within or abutting the area. All areas shall be clearly identified on the

maps/sheets/aerial photographs. Each area must be approved in writing by the Director of OEP **before construction in or near that area**.

a. This requirement does not apply to extra workspace allowed by Sabine Pass' Upland Erosion Control, Revegetation, and Maintenance Plan.

b. Examples of alterations requiring approval include facility location changes resulting from:

(1) implementation of cultural resources mitigation measures;

(2) implementation of endangered, threatened, or special concern species mitigation measures; and

(3) recommendations by state regulatory authorities.

6. **Within 60 days of the acceptance of the Certificate and before construction begins**, Sabine Pass shall file an Implementation Plan with the Secretary for review and written approval by the Director of OEP. Sabine Pass must file revisions to the plan as schedules change. The plan shall identify:

a. how Sabine Pass will implement the construction procedures and mitigation measures described in its application and supplements (including responses to staff data requests), identified in the EA, and required by the Order;

b. how Sabine Pass will incorporate these requirements into the contract bid documents, construction contracts (especially penalty clauses and specifications), and construction drawings so that the mitigation required at each site is clear to onsite construction and inspection personnel;

c. the number of EIs assigned, and how the company will ensure that sufficient personnel are available to implement the environmental mitigation;

d. company personnel, including EIs and contractors, who will receive copies of the appropriate material;

e. the location and dates of the environmental compliance training and instructions Sabine Pass will give to all personnel involved with construction and restoration (initial and refresher training as the project progresses and personnel change, with the opportunity for OEP staff to participate in the training sessions);

f. the company personnel (if known) and specific portion of Sabine Pass' organization having responsibility for compliance;

g. the procedures (including use of contract penalties) Sabine Pass will follow if noncompliance occurs; and

h. for each discrete facility, a Gantt or PERT chart (or similar project scheduling diagram), and dates for:

(1) the completion of all required surveys and reports;

(2) the environmental compliance training of onsite personnel;

(3) the start of construction; and

(4) the start and completion of restoration.

7. Beginning with the filing of its Implementation Plan, Sabine Pass shall file updated status reports with the Secretary on a monthly basis until all construction and restoration activities are complete. On request, these status reports will also be provided to other federal and state agencies with permitting responsibilities. Status reports shall include:
   a. an update on Sabine Pass' efforts to obtain the necessary federal authorizations;
   b. the construction status of the Project, work planned for the following reporting period, and any schedule changes for stream crossings or work in other environmentally-sensitive areas;
   c. a listing of all problems encountered and each instance of noncompliance observed by the EI(s) during the reporting period (both for the conditions imposed by the Commission and any environmental conditions/permit requirements imposed by other federal, state, or local agencies);
   d. a description of the corrective actions implemented in response to all instances of noncompliance, and their cost;
   e. the effectiveness of all corrective actions implemented;
   f. copies of any correspondence received by Sabine Pass from other federal, state, or local permitting agencies concerning instances of noncompliance, and Sabine Pass' response.
8. **Prior to receiving written authorization from the Director of OEP to commence construction of any project facilities**, Sabine Pass shall file with the Secretary documentation that it has received all applicable authorizations required under federal law (or evidence of waiver thereof).
9. Sabine Pass must receive written authorization from the Director of OEP **before placing into service** either Stage 1 or Stage 2 of the Project. Such authorization will only be granted following a determination that the facilities have been constructed in accordance with FERC approval and applicable standards, can be expected to operate safely as designed, and the rehabilitation and restoration of the areas affected by the project are proceeding satisfactorily.
10. **Within 30 days of placing the authorized facilities in service**, Sabine Pass shall file an affirmative statement with the Secretary, certified by a senior company official:
    a. that the facilities have been constructed in compliance with all applicable conditions, and that continuing activities will be consistent with all applicable conditions; or
    b. identifying which of the Certificate conditions Sabine Pass has complied with or will comply with. This statement shall also identify any areas affected by the project where compliance measures were not properly implemented, if not previously identified in filed status reports, and the reason for noncompliance.
11. **Prior to construction**, Sabine Pass shall file a Fugitive Dust Control Plan with the Secretary, for review and written approval of the Director of OEP. The plan shall specify the following:
    a. the precautions that Sabine Pass would take to minimize fugitive dust emissions from construction activities, including additional mitigation measures to control fugitive dust emissions of TSP and PM10;
    b. the individuals with the authority to determine if/when water needs to be reapplied for dust control;
    c. the individuals with the authority to determine if/when a palliative needs to be used;

d. the individuals with the authority to stop work if the contractor does not comply with dust control measures; and

e. additional dust control measures, including:

(1) measures to limit track-out onto the roads;

(2) the speed limit that Sabine Pass would enforce on unsurfaced roads; and

(3) covering open-bodied haul trucks, as appropriate.

12. Sabine Pass shall file a noise survey with the Secretary **no later than 60 days** after each stage of the Sabine Pass Liquefaction Project facilities are placed into service. If the noise attributable to operation of the SPLNG Terminal and liquefaction facilities exceeds an Ldn of 55 dBA at any nearby NSA, Sabine Pass shall file a report on what changes are needed and shall install additional noise controls to meet that level **within 1 year** of the in-service date. Sabine Pass shall confirm compliance with the above requirement by filing a second noise survey with the Secretary **no later than 60 days** after it installs the additional noise controls.

The following measures shall apply to the Sabine Pass LNG terminal. Information pertaining to these recommendations 13 through 50 shall be filed with the Secretary for review and written approval by the Director of OEP either: prior to initial site preparation; prior to construction of final design; prior to commissioning; or prior to introduction of natural gas or process fluids, as indicated by each specific condition. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 683 (Docket No. RM06-24-000), including security information, shall be submitted as critical energy infrastructure information (CEII) pursuant to 18 CFR 388.112. See Critical Energy Infrastructure Information, Order No. 683, 71 Fed. Reg. 58,273 (October 3, 2006), FERC Stats. & Regs. ¶31,228 (2006). Information pertaining to items, such as off-site emergency response, procedures for public notification and evacuation, and construction and operating reporting requirements would be subject to public disclosure. All information shall be filed a minimum of 30 days before approval to proceed is requested.

13. A complete plan and list of the hazard detection equipment shall be filed **prior to initial site preparation**. The information shall include a list with the instrument tag number, type and location, alarm locations, and shutdown functions of the proposed hazard detection equipment. Plan drawings shall clearly show the location of all detection equipment.

14. **Prior to initial site preparation**, Sabine Pass shall file a technical review of its proposed facility design that:

a. Identifies all combustion/ventilation air intake equipment and the distances to any possible flammable release (i.e., LNG, flammable refrigerants, flammable liquids and flammable gases).

b. Demonstrates that these areas are adequately covered by hazard detection devices and indicates how these devices would isolate or shut down any combustion equipment whose continued operation could add to or sustain an emergency.

15. A complete plan and list of the fixed and wheeled dry-chemical, fire extinguishing, and high-expansion-foam hazard control equipment shall be filed **prior to initial site preparation**. The information shall include a list with the equipment tag number, type, size, equipment

covered, and automatic and manual remote signals initiating discharge of the units. Plan drawings shall clearly show the planned location of all fixed and wheeled extinguishers.

16. Facility plans showing the proposed location of, and area covered by, each monitor, hydrant, deluge system, hose, and sprinkler, as well as piping and instrumentation diagrams of the firewater system, shall be filed **prior to initial site preparation**.

17. An overall project schedule, which includes the proposed stages of the commissioning plan, shall be filed **prior to initial site preparation**.

18. A vapor dispersion analysis from a liquid ethylene design spill shall be filed **prior to initial site preparation**.

19. Procedures for controlling access during construction and operation to the Kinder Morgan meter station shall be filed **prior to initial site preparation**.

20. An updated Emergency Response Plan which includes the liquefaction facilities as well as instructions to handle on-site refrigerant-related emergencies shall be filed **prior to initial site preparation.**

21. The Emergency Response Plan shall include a Cost-Sharing Plan identifying the mechanisms for funding all Project-specific security/emergency management costs that would be imposed on state and local agencies. In addition to the funding of direct transit-related security/emergency management costs, this comprehensive plan shall include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. The Cost-Sharing Plan shall be filed **prior to initial site preparation**.

22. The **final design** shall address the information/revisions as described in Sabine Pass' responses to the Engineering Information Requests identified in Table 2.8-1 of the Environmental Assessment.

23. The **final design** of the fixed and wheeled dry-chemical fire extinguishing equipment, and high-expansion-foam hazard control equipment shall identify manufacturer and model.

24. The **final design** shall include an updated fire protection evaluation of the existing and proposed facilities carried out in accordance with the requirements of National Fire Protection Association (NFPA) 59A 2001, chapter 9.1.2. The evaluation shall assess the potential need for additional firewater capacity to address multiple fire scenarios occurring in different locations of the plant and occurring simultaneously.

25. The **final design** shall demonstrate the ability to provide firewater coverage for Case 1 and Case 2 of the Firewater Network Analysis, filed on April 19, 2011, for the proposed liquefaction facilities.

26. The **final design** shall include an acid gas vent stack dispersion analysis to determine the proper placement of hazard detection devices that ensures venting is done in a safe manner.

27. The **final design** shall provide up-to-date Piping and Instrument Diagrams (P&IDs), which include the following information:

    a. equipment tag number, name, size, duty, capacity, and design conditions;

    b. equipment insulation type and thickness;

    c. refrigerant storage tank pipe penetration size or nozzle schedule;

    d. piping with line number, piping class specification, size, and insulation type and thickness;

e. piping specification breaks and insulation limits;

f. all control and manual valves numbered;

g. relief valves with set points; and

h. drawing revision number and date.

28. The **final design** shall include details of the shutdown logic, including cause-and-effect matrices for alarms and shutdowns.

29. The **final design** of the LNG storage tank piping and supports shall be reviewed and approved by the tank manufacturer to verify the existing design is adequate to support the higher rated in-tank pump flow rates.

30. The **final design** shall specify that the Waste Heat Recovery Unit coil design temperature, at the design pressure, is consistent with the maximum design temperature of the turbine exhaust.

31. The **final design** shall include a relief valve study to ensure the existing LNG storage tank vacuum relief valves provide adequate protection with the higher capacity in-tank pumps operating at full capacity.

32. The **final design** shall specify that for LNG, natural gas, and refrigerant service, stainless steel and carbon steel branch piping and piping nipples are consistent with the existing facility's specifications.

33. The **final design** shall include a hazard and operability review of the completed design. A copy of the review and a list of recommendations, and actions taken on the recommendations, shall be filed.

34. The **final design** shall provide P&IDs, specifications, and procedures that clearly show and specify the tie-in details required to safely connect the Stage 2 facilities.

35. The **final design** of the hazard detectors shall account for the calibration gas when determining the Lower Flammability Limit (LFL) set points for methane, propane, and ethylene.

36. The **final design** shall include a plan for clean-out, dry-out, purging, and tightness testing. This plan shall address the requirements of the American Gas Association's Purging Principles and Practice required by 49 CFR 193 and shall provide justification for not using an inert or non-flammable gas for clean-out, dry-out, purging, and tightness testing.

37. The **final design** shall include operating procedures that specify the loading rate would not exceed 12,000 m^3/hr.

38. The **final design** shall include procedures to maintain and inspect the vapor barriers provided to meet the siting provisions of 49 CFR §193.2059.

39. The **final design** shall either provide plant geometry models or drawings that verify the confinement and congestion represented in the front-end-engineering design of the liquefaction facilities or provide revised overpressure calculations indicating that a 1 psi overpressure would not impact the public.

40. All valves, including drain, vent, instrument root, main, and car sealed valves, shall be tagged in the field **prior to commissioning**.

41. A tabulated list of the proposed hand-held fire extinguishers shall be filed **prior to commissioning**. The lists shall include the equipment tag number, type, size, number, and

location. The type, size, and tag number of all hand-held fire extinguishers shall be shown on facility plot plan(s).

42. Operation and maintenance procedures and manuals, as well as safety procedure manuals, shall be filed **prior to commissioning**.

43. Sabine Pass shall complete the firewater system coverage test **prior to commissioning**. The actual coverage area from each monitor and hydrant shall be shown on the facility plot plan(s).

44. Sabine Pass shall complete all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, and Site Integration Tests) associated with the Distributed Control System (DCS) that demonstrates full functionality and operability of the system **prior to commissioning**.

45. Sabine Pass shall maintain a detailed training log to demonstrate that operating staff has completed the required training **prior to commissioning**.

46. **Prior to commissioning**, Sabine Pass shall file a copy of the Mechanical Completion Certificate and any documentation (i.e., punch list items) that certifies that the facility is installed and mechanically tested according to the final design and specifications.

47. Sabine Pass shall file a plan for functional and operational tests of the final design **prior to commissioning**.

48. Sabine Pass shall complete instrumentation functional tests, hazard detection equipment functional tests, and emergency shutdown (ESD) tests **prior to introduction of natural gas or process fluids**.

49. Sabine Pass must receive written authorization from the Director of OEP **prior to introducing natural gas or process fluids** into the Project facilities. At a minimum, instrumentation and controls, hazard detection, hazard control, and security components/systems shall be installed and functional.

50. Progress on the construction of the LNG terminal shall be reported in monthly reports filed with the Secretary. Details shall include a summary of activities, problems encountered, contractor non-conformance/deficiency logs, remedial actions taken, and current project schedule. Problems of significant magnitude shall be reported to the FERC **within 24 hours**.

Recommendations 51 through 53 shall apply throughout the life of the facility:

51. The facility shall be subject to regular FERC staff technical reviews and site inspections on at least an **annual basis** or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, Sabine Pass shall respond to a specific data request, including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed piping and instrumentation diagrams reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted semi-annual report, shall be submitted.

52. Semi-annual operational reports shall be filed with the Secretary to identify changes in facility design and operating conditions, abnormal operating experiences, activities (including ship arrivals, quantity and composition of imported and exported LNG, liquefied and vaporized quantities, boil-off/flash gas, etc.), plant modifications, including future plans and progress thereof. Abnormalities shall include, but not be limited to: unloading/loading/shipping problems, potential hazardous conditions from off-site vessels, storage tank stratification or rollover, geysering, storage tank pressure excursions, cold spots on the storage tanks, storage tank vibrations and/or vibrations in associated cryogenic piping,

storage tank settlement, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, vapor or liquid releases, fires involving natural gas and/or from other sources, negative pressure (vacuum) within a storage tank and higher than predicted boil-off rates. Adverse weather conditions and the effect on the facility also shall be reported. Reports shall be submitted **within 45 days after each period ending June 30 and December 31**. In addition to the above items, a section entitled "Significant Plant Modifications Proposed for the Next 12 Months (dates)" also shall be included in the semi-annual operational reports. Such information would provide FERC staff with early notice of anticipated future construction/maintenance projects at the LNG facility.

53. Significant non-scheduled events, including safety-related incidents (e.g., LNG, refrigerant, or natural gas releases, fires, explosions, mechanical failures, unusual over pressurization, and major injuries) and security-related incidents (e.g., attempts to enter site, suspicious activities) shall be reported to FERC staff. In the event an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification shall be made **immediately**, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification shall be made to FERC staff **within 24 hours**. This notification practice shall be incorporated into the LNG facility's emergency plan. Examples of reportable LNG or refrigerant related incidents include:

    a. fire;

    b. explosion;

    c. estimated property damage of $50,000 or more;

    d. death or personal injury necessitating in-patient hospitalization;

    e. release of LNG or refrigerants for five minutes or more;

    f. unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes gas, refrigerants, or LNG;

    g. any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes gas, refrigerants, or LNG;

    h. any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes gas, refrigerants, or LNG to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure limiting or control devices;

    i. a leak in an LNG facility that contains or processes gas, refrigerants, or LNG that constitutes an emergency;

    j. inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;

    k. any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or an LNG facility that contains or processes gas, refrigerants, or LNG;

    l. safety-related incidents to LNG or refrigerant vessels occurring at or en route to and from the LNG facility; or

m. an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan.

In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property or the environment, including authority to direct the LNG facility to cease operations. Following the initial company notification, FERC staff would determine the need for a separate follow-up report or follow-up in the upcoming semi-annual operational report. All company follow-up reports shall include investigation results and recommendations to minimize a reoccurrence of the incident.

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Appendix A Horizontal Directional Drilling (HDD) Drilling Mud/Frac-out Contingency Plan

Horizontal Directional Drilling (HDD)
Drilling Mud/Frac-out Contingency Plan

I. Purpose and Objective

All stages of horizontal directional drilling (HDD) operations involve circulating drilling fluid from equipment on the surface, through a drill pipe, and back to the surface through the drilled annulus. Drilling fluid plays a critical role in the HDD process including transportation of soil and rock cuttings to the surface and stabilization of the hole. Just as critical, the fluid reduces drilling friction, cools and cleans the drill cutters, transmits hydraulic power to the drill bit, and performs the hydraulic excavation of the cuttings.

The primary component of drilling fluid used in HDD pipeline installation is water. To enhance the fluid performance, a viscosifier may be added to the water to improve its properties. The primary viscosifier used on HDD installations is the naturally occurring bentonite clay. Specific soils and drilling conditions may require the addition of various constituents to vary the properties of the drilling fluid to meet the needs of the particular situation.

The most likely occurrence of inadvertent mud developing during the drilling operations is from 'frac-outs'. Frac-outs usually occur when the down-hole pressures are too high and overcome the restraining forces of the surrounding formation. This most often occurs during the pilot hole drilling operations when the pressures are the highest. Therefore, moderation of down-hole pressures aid in avoiding frac-outs. The nature of the soil formation in the project area is mainly silt, clay and some sand which lends itself to reducing frac-outs.

The purpose of this plan is to identify procedures to be followed in the event of a frac-out involving an inadvertent drilling mud release during HDD operations. A frac-out is a condition in which drilling mud is released through fractures in the soil and migrates toward the surface. Drilling mud consists mainly of a bentonite clay-water mixture, which is not considered to be hazardous or toxic. However, the objective is to minimize the potential of a frac-out and identify response measures in the event that a frac-out occurs, in order to mitigate any potential adverse impact to waterbodies, wetlands and associated habitats. Escape of drilling mud from a frac-out is most common near the directional drill entry and exit locations. However, frac-outs can occur at any location along a directional drill.

This plan provides operational procedures and responsibilities for the prevention, containment, and clean-up of frac-outs associated with HDD operations.

The objectives of this plan includes:

- Minimize the potential for a frac-out due to HDD operations.
- Identify timely detection of frac-outs.

- Provide for environmental protection of sensitive resources such as waterbodies, wetlands and associated habitats.
- Establish response procedures in the event of a frac-out.

II. Layout and Design for Horizontal Directionally Drilled Crossings

The pipeline alignment drawings show the targeted entry and exit locations and staging areas for HDD crossings. These layouts have been designed to minimize the potential for impacts to waterbodies and wetlands by providing no less than 50 foot buffers to the sensitive resource. Additionally, the entry and exit locations have been sited with maximum design depth clearance to provide the greatest buffer between the sensitive resource and the drilling activity/installed pipe. The combination of the buffer and the depth of the pipe beneath the sensitive resource is anticipated to minimize and avoid any adverse impacts.

III. Environmental Inspection and Training

Prior to the start of construction, Cheniere's Environmental Inspector (EI) will conduct a training session with all key contractor, drilling and inspection personnel. All personnel working at the HDD site will be thoroughly trained in the applicable frac-out contingency plan items. In addition, the EI will ensure that the contractor has proper equipment and materials available on-site at all times or access to them in a timely manner, and that the necessary procedures are followed. Tailgate meetings will ensure ongoing effective communications and awareness measures regarding prevention, mitigation and response associated with potential frac-outs.

IV. Mitigation Measures

- All equipment will be checked and maintained daily.
- Sufficient supplies of spill containment materials and hay bales will be available on-site at all times.
- Frac-out barrels will be located on-site at all times.
- Entry and exit drill pits will be contained utilizing berms and/or sediment control devices where possible. Any abandoned HDD drill holes will be filled and capped with native material or a grout mixture.
- Visual observation (on-land and sensitive resources) will occur on a regular basis throughout HDD operations so that a potential surface frac-out can be identified.
- At the first sign of release of drilling fluids (frac-out) the contractor will take immediate actions to control the release. Depending on the location and the amount of fluid being released, the actions taken may include:
    - Stop or slowing the drilling operations and stop or reduce the mud pumping to allow time for the leak to self-heal
    - Reduce the drilling fluid pressures
    - Add thickening or blocking additives to the fluid mixture.

- In the event of a frac-out, the on-site EI will evaluate the situation and provide direction for mitigation actions.
- Clean up of all frac-outs/spills shall begin immediately.
- In the event of a frac-out that reaches the surface, but not the sensitive resource, bentonite shall be contained, removed and disposed at an approved facility.
- In the event that a frac-out reaches a sensitive resource, corrective action will be taken immediately. Clean-up work will be performed by hand to the extent possible. A vacuum truck will be used to vacuum up the associated bentonite and soils as necessary. The materials will be properly disposed at an approved facility.
- All cleanup materials will be disposed on a daily basis as applicable, and at the completion of the project.
- In the event that a drill hole must be abandoned, the bore will be sealed by the injection of a high-viscosity bentonite slurry.
- Documentation will be prepared for any frac-outs that occur during HDD operations.

V. Notifications

- In the event of a frac-out, the EI shall immediately notify Cheniere's Environmental Department.
- Applicable regulatory agencies will be contacted as required should a frac-out occur. The EI will have a complete list of the applicable agencies should a response notification be required.
- In the event of a frac-out in wetlands or waters of the Unites States, the Environmental Inspector (EI) will immediately notify the Army Corps of Engineers, Regulatory Branch. If cleanup activities require addition of fill material or work in jurisdictional areas, the EI will consult with the Army Corps of Engineers, Regulatory Branch designated point of contact prior to start of work in jurisdictional areas.